883A

AC/DC Differential Voltmeter

LITTLE MOUNTAIN

Instruction Manual

FLUKE®

P/N 294231
March 1966

WARRANTY

Notwithstanding any provision of any agreement the following warranty is exclusive:

The JOHN FLUKE MFG. CO., INC., warrants each instrument it manufactures to be free from defects in material and workmanship under normal use and service for the period of 1-year from date of purchase. This warranty extends only to the original purchaser. This warranty shall not apply to fuses, disposable batteries (rechargeable type batteries are warranted for 90-days), or any product or parts which have been subject to misuse, neglect, accident, or abnormal conditions of operations.

In the event of failure of a product covered by this warranty, John Fluke Mfg. Co., Inc., will repair and calibrate an instrument returned to an authorized Service Facility within 1 year of the original purchase; provided the warrantor's examination discloses to its satisfaction that the product was defective. The warrantor may, at its option, replace the product in lieu of repair. With regard to any instrument returned within 1 year of the original purchase, said repairs or replacement will be made without charge. If the failure has been caused by misuse, neglect, accident, or abnormal conditions of operations, repairs will be billed at a nominal cost. In such case, an estimate will be submitted before work is started, if requested.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS, OR ADEQUACY FOR ANY PARTICULAR PURPOSE OR USE. JOHN FLUKE MFG. CO., INC., SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTRACT, TORT, OR OTHERWISE.

If any failure occurs, the following steps should be taken:

1. Notify the JOHN FLUKE MFG. CO., INC., or nearest Service facility, giving full details of the difficulty, and include the model number, type number, and serial number. On receipt of this information, service data, or shipping instructions will be forwarded to you.

2. On receipt of the shipping instructions, forward the instrument, transportation prepaid. Repairs will be made at the Service Facility and the instrument returned, transportation prepaid.

SHIPPING TO MANUFACTURER FOR REPAIR OR ADJUSTMENT

All shipments of JOHN FLUKE MFG. CO., INC., instruments should be made via United Parcel Service or "Best Way" prepaid. The instrument should be shipped in the original packing carton; or if it is not available, use any suitable container that is rigid and of adequate size. If a substitute container is used, the instrument should be wrapped in paper and surrounded with at least four inches of excelsior or similar shock-absorbing material.

CLAIM FOR DAMAGE IN SHIPMENT TO ORIGINAL PURCHASER

The instrument should be thoroughly inspected immediately upon original delivery to purchaser. All material in the container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If the instrument is damaged in any way, a claim should be filed with the carrier immediately. (To obtain a quotation to repair shipment damage, contact the nearest Fluke Technical Center.) Final claim and negotiations with the carrier must be completed by the customer.

The JOHN FLUKE MFG. CO., INC. will be happy to answer all applications or use questions, which will enhance your use of this instrument. Please address your requests or correspondence to: JOHN FLUKE MFG. CO., INC., P.O. BOX 43210, MOUNTLAKE TERRACE, WASHINGTON 98043, ATTN: Sales Dept. For European Customers: Fluke (Holland) B.V., P.O. Box 5053, 5004 EB, Tilburg, The Netherlands.

*For European customers, Air Freight prepaid.

John Fluke Mfg. Co., Inc., P.O. Box 43210, Mountlake Terrace, Washington 98043

Rev. 4/80

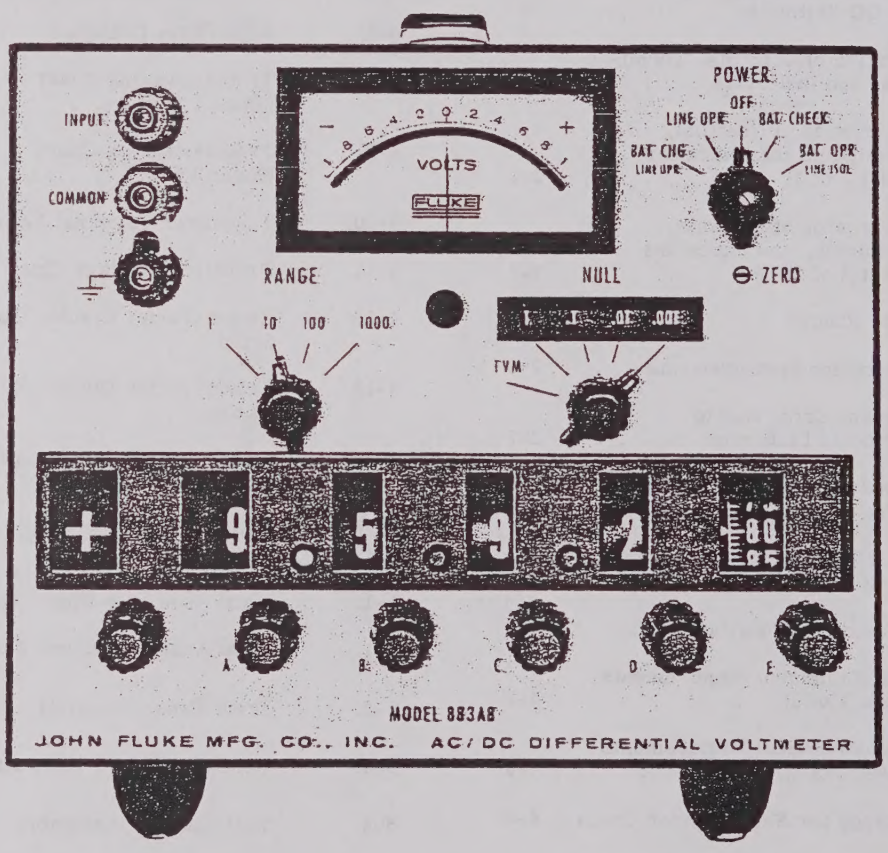
TABLE OF CONTENTS

SECTION	TITLE	PAGE
I	INTRODUCTION & SPECIFICATIONS	1-1
	1-1. Introduction	1-1
	1-5. Input Power	1-1
	1-7. Damage in Shipment	1-1
	1-9. Specifications	1-2
II	OPERATING INSTRUCTIONS	2-1
	2-1. Function of External Controls, Terminals and Indicators	2-1
	2-3. Preliminary Operation for Model 883A	2-1
	2-5. Preliminary Operation for Model 883AB	2-3
	2-7. Zeroing Instructions	2-3
	2-9. Battery Charging	2-3
	2-10. Operation as a DC Differential Voltmeter	2-4
	2-11. Operation as an AC Differential Voltmeter	2-4
	2-12. Operation as a Conventional Voltmeter	2-4
	2-14. Measurement of Voltage Excursions about a Nominal Value	2-4
	2-15. Recording Voltage Excursions	2-5
	2-17. Use of 883A with an A88 Isolation Amplifier and a Recorder	2-5
	2-19. Use of 883A with a Recorder	2-5
	2-21. Measurement of High Resistance	2-5
	2-24. Notes on Measuring AC or DC Voltages	2-6
	2-25. Ground Loop Precautions	2-6
	2-27. Use of Shorting Link	2-6
	2-29. Battery Checking	2-6
	2-31. Effect of Common Mode Voltages	2-6
	2-33. Notes on Measuring DC Voltages	2-6
	2-34. Effect of AC Components on DC Measurements	2-6
	2-36. Measurement of Negative Voltages	2-7
	2-38. Notes on Measuring AC Voltages	2-7
	2-39. Errors Due to Distortion	2-7
	2-41. Errors Due to Grounding	2-7
	2-43. Internal Converter Noise	2-7
	2-45. Most Sensitive Null Range on AC	2-8
III	THEORY OF OPERATION	3-1
	3-1. Introduction	3-1
	3-5. DC Input Attenuator	3-2
	3-7. DC Transistorized Voltmeter	3-2
	3-8. General	3-2
	3-10. Null Detector	3-2
	3-12. TVM Attenuator	3-2
	3-15. Input Resistance	3-3
	3-18. Chopper Drive Circuit	3-3
	3-20. Null Detector Power Supply	3-3
	3-22. Effect of AC Components on DC Measurements.	3-3
	3-24. TVM Gain and Zero Adjustments	3-3
	3-26. Recorder Output	3-4
	3-28. 0 to 11 Volt Reference	3-4
	3-29. General	3-4
	3-31. -18 Volt Power Supply	3-4
	3-33. Range Divider	3-4
	3-35. Kelvin-Varley Divider	3-4
	3-37. Adjustments	3-4
	3-39. AC to DC Converter	3-5
	3-40. General	3-5
	3-42. Converter Power Supply	3-5
	3-44. Operation	3-5
	3-46. Adjustments	3-5
	3-48. AC-DC Polarity Switch	3-5
IV	MAINTENANCE	4-1
	4-1. Introduction	4-1
	4-3. Test Equipment	4-1
	4-5. Periodic Maintenance	4-1
	4-8. Performance Checking	4-1
	4-9. General	4-1
	4-11. Null Detector Check	4-4
	4-13. DC Differential Measurement Check	4-4
	4-15. AC Measurement Check	4-6
	4-17. Calibration	4-6
	4-18. General	4-6
	4-20. DC Differential Voltmeter Calibration	4-7
	4-27. AC to DC Converter Calibration	4-9
	4-38. Corrective Maintenance	4-10
	4-39. General	4-10
	4-41. Troubleshooting	4-10
	4-52. Electronic Adjustments	4-15
	4-61. Mechanical Drum Adjustments	4-17

SECTION	TITLE	PAGE
V	LIST OF REPLACEABLE PARTS	5-1
	5-1. Introduction	5-1
	5-4. Column Description	5-1
	5-5. How to Obtain Parts	5-2
	5-8. List of Abbreviations	5-2
	5-9. Serial Number Effectivity	5-26
VI	ACCESSORIES	6-1
	6-1. Precision Voltage Dividers	6-1
	6-3. Isolation Amplifier	6-2
VII	GENERAL INFORMATION	7-1
VIII	SCHEMATIC	8-1

LIST OF ILLUSTRATIONS

FIGURE	TITLE	PAGE
Frontis-piece	Model 883A Differential AC/DC Voltmeter	v
2-1.	Location of Controls, Terminals, and Indicators	2-1
2-2.	Description of Controls, Terminals, and Indicators (Sheet 1 of 2)	2-2
2-2.	Description of Controls, Terminals, and Indicators (Sheet 2 of 2)	2-3
2-3.	TVM Ranges	2-4
2-4.	Resistance Measurements	2-6
2-5.	Percent Error Due to Harmonic Distortion	2-7
2-6.	Signal Voltage With Converter Noise	2-8
3-1.	883A Differential Voltmeter Block Diagram	3-1
3-2.	Function of Polarity Switch	3-6
4-1.	Test Equipment Requirements (Sheet 1 of 2)	4-2
4-1.	Test Equipment Requirements (Sheet 2 of 2)	4-3
4-2.	Settings for Null Detector Check	4-4
4-3.	Differential Measurement Check and Calibration Setup	4-4
4-4.	Reference Supply and External Kelvin-Varley Divider Check Setup	4-5
4-5.	Voltage Readout Dial Limits	4-6
4-6.	AC to DC Converter Calibration Setup	4-6
4-7.	AC Measurement Check	4-7
4-8.	Adjustment Locations	4-7
4-9.	Troubleshooting Chart (Sheet 1 of 2)	4-10
4-9.	Troubleshooting Chart (Sheet 2 of 2)	4-11
4-10.	Transistor Terminal Locations	4-12
4-11.	Transistor Voltage Chart	4-13
4-12.	Kelvin-Varley Divider Check Setup	4-15
4-13.	Kelvin-Varley Divider Error Limits	4-16
4-14.	Kelvin-Varley Divider Adjustment Setup	4-17
4-15.	Kelvin-Varley "A" Deck Adjustment	4-18
5-1.	Final Assembly (Sheet 1 of 2)	5-4
5-1.	Final Assembly (Sheet 2 of 2)	5-5
5-2.	Front Panel Assembly	5-7
5-3.	Reference Supply Assembly	5-9
5-4.	Null Detector Assembly	5-12
5-5.	Kelvin-Varley Assembly	5-16
5-6.	Attenuator Assembly (S/N 123 thru 891)	5-18
5-7.	Attenuator Assembly (S/N 892 and on)	5-20
5-8.	Converter Assembly	5-22



MODEL 883A DIFFERENTIAL AC/DC VOLTMETER

SECTION I

INTRODUCTION AND SPECIFICATIONS

1-1. INTRODUCTION

1-2. This instruction manual is for use with the 883A series Differential AC/DC voltmeters. These are available as either a line-powered instrument (Model 883A) or as a combination line-powered or battery-powered instrument (Model 883AB). Both instruments are half rack size and are equipped with resilient feet and tilt-up bail for field or bench use. A single instrument may be mounted in a standard 19 inch rack by means of metal handle rack adapter kit 881A-102. Two instruments may be mounted side-by-side by means of metal handle rack adapter kit 881A-103.

1-3. The 883A series instruments are capable of being used as conventional voltmeters for rapid determination of voltages from 0 to 1100 volts dc and from 0.001 to 1100 volts ac to within ±3% of range setting, as differential voltmeters for precise measurement of dc voltages from 0 to 1100 volts to within ±(0.01% of input voltage + 5 uv), as an accurate ac voltmeter for measurement of ac voltages from 0.001 to 1100 volts to within ±(0.1% of input voltage + 25 uv) from 20 Hz to 5 kHz and with reduced accuracy from 5 Hz to 100 kHz, and as megohmmeters for measurements of resistance from 10 megohms to 11,000 megohms with a typical accuracy of 5%. They can also be used to measure the excursions of a voltage about some nominal value. One feature that should be emphasized is that no current is drawn from the unknown source at null up to 11 volts dc. Thus the determination of the unknown potential is independent of its source resistance. Above 11 volts dc, the input resistance is an excellent 10 megohms. To minimize errors due to common mode voltages, the 883A series is provided with extremely high leakage resistance to ground --- typically several hundred thousand megohms. Also, where ground loops errors are a problem, the battery operated mode of the 883AB eliminates these errors due to complete isolation from the power line. As additional features, the 883A series contains a polarity switch for equal convenience in measuring positive or negative dc voltages and an adjustable recorder output which makes the instrument particularly useful for monitoring the stability of almost any ac or dc voltage. Furthermore, thorough shock, vibration, humidity, and temperature testing assure years of hard use under severe environmental conditions.

1-4. When used as a dc differential voltmeter, the 883A operates on the potentiometric principal. An unknown voltage is measured by comparing it to a known adjustable voltage with the aid of a null detector. An accurate standard for measurement is obtained from an 11 volt dc reference supply derived from a pair of temperature-compensated zener diodes. The known adjustable reference voltage is provided by a Kelvin-Varley voltage divider with four decades of FLUKE precision wirewound resistors and a high-resolution interpolating vernier that are set accurately by five voltage readout dials to give a six digit readout. In this way, the 11 volts can be precisely divided into increments smaller than 10 microvolts. The unknown voltage is then simply read from the voltage dials. For voltages between 11 and 1100 volts dc, an input attenuator divides the unknown voltage by 100 before it is measured potentiometrically. When used as an accurate ac voltmeter, the 883A operates essentially the same as for dc differential measurements. The ac input voltage is converted to a dc voltage and this dc voltage is measured by comparing it to a known adjustable reference voltage.

1-5. INPUT POWER

1-6. Like most FLUKE instruments, the 883A is normally supplied with dual primary windings connected in parallel for 115 volt line operation. Upon request, the instrument is supplied for 230 volt line operation with the primary windings connected in series. If it becomes desirable to convert from one mode of operation to the other, refer to the instruction decal on the power transformer.

1-7. DAMAGE IN SHIPMENT

1-8. Immediately upon receipt, thoroughly inspect the instrument for any damage that may have occurred in transit. If any damage is noted, follow the instructions outline on the warranty page at the back of this manual.

1-9. SPECIFICATIONS

AS A DIFFERENTIAL VOLTMETER

DC ACCURACY: ± (0.01% of input voltage + 5 uv) over the complete operating conditions listed under general specifications.

DC ACCURACY UNDER CONTROLLED ENVIRONMENT: ± (0.005% of input voltage + 0.0002% of range setting + 5 uv) at 73° F (23° C). Derated at 0.0002%/° F (0.0004%/° C) from 73° F (23° C) between 55° F and 95° F (13° C and 35° C).

AC ACCURACY:

Input Voltage	Basic AC Accuracy		Low Frequency AC Accuracy		High Frequency AC Accuracy	
	20 Hz to 5 kHz	5 kHz to 10 kHz	10 Hz to 20 Hz	5 Hz to 10 Hz	10 kHz to 20 kHz	20 kHz to 100 kHz
0.001 to 1100V	±(0.1% + 25uv)	±(0.15% + 25uv)	±(0.3% + 25uv)	±(1% + 25uv)	–	–
0.1 to 1100	–	–	–	–	±0.3%	–
0.1 to 110	–	–	–	–	–	±1%

AC ACCURACY UNDER CONTROLLED ENVIRONMENT: ± (0.06% of input voltage + 0.002% of range + 25 uv) from 0.001 to 500 volts and ± 0.08% of input voltage from 500 to 1100 volts between 30 Hz and 5 kHz at 73° F (23° C). Derated at 0.0015%/° F from 73° F between 55° F and 95° F (13° C and 35° C).

RANGE:

Voltage Range	Null Range	DC Input Resistance at Null	AC Input Impedance
1	0.1-0-0.1	Infinite	1 Meg, 40 pf
	0.01-0-0.01	Infinite	"
	0.001-0-0.001	Infinite	"
	0.0001-0-0.0001	Infinite	"
10	1-0-1	Infinite	"
	0.1-0-0.1	Infinite	"
	0.01-0-0.01	Infinite	"
	0.001-0-0.001	Infinite	"
100	10-0-10	10 Meg	"
	1-0-1	10 Meg	"
	0.1-0-0.1	10 Meg	"
	0.01-0-0.01	10 Meg	"
1000	100-0-100	10 Meg	"
	10-0-10	10 Meg	"
	1-0-1	10 Meg	"
	0.1-0-0.1	10 Meg	"

NOTE: Each voltage range and each null range has the capability of measuring 10% over voltage.

RESOLUTION:

Voltage Readout Dial Resolution			
Voltage Range	Null Range	Resolution	
		ppm of Voltage Range	Volts
1	any	1 ppm	1 uv
10	"	1 ppm	10 uv
100	"	1 ppm	100 uv
1000	"	1 ppm	1 mv

Meter Resolution (1/2 of a small meter scale division)		
Voltage Range	Null Range	Resolution
any	0.0001	1 uv
"	0.001	10 uv
"	0.01	100 uv
"	0.1	1 mv
"	1	10 mv
"	10	100 mv
"	100	1 v

AS A CONVENTIONAL VOLTMETER

ACCURACY: ± 3% of range from 0 to 1100 vdc and 0.001 to 1100 vac.

RANGE:

Voltage Range	DC Input Resistance	AC Input Impedance
1000-0-1000	10 Meg	1 Meg, 40 pf
100-0-100	"	"
10-0-10	"	"
1-0-1	"	"
*0.1-0-0.1	"	"
*0.01-0-0.01	"	"
*0.001-0-0.001	1 Meg	"
*0.0001-0-0.0001	"	"

*These ranges are obtained by using null ranges with all five voltage dials set to zero.

NOTE: Each range has the capability of measuring 10% overvoltage.

GENERAL

ELECTRICAL DESIGN: Completely solid-state.

INPUT RESISTANCE OF NULL DETECTOR: 10 megohms on two highest null ranges for all input ranges; 1 megohm on two lowest null ranges for all input ranges.

REFERENCE ELEMENT: Temperature-compensated zener diode, stability within ±15 ppm per year, and temperature coefficient less than 2 ppm/° C.

REGULATION OF REFERENCE SUPPLY: 0.0005% for a 10% line voltage change.

STABILITY OF REFERENCE SUPPLY: ±0.001% per hour after 5 minute warmup.

ACCURACY OF OFF-NULL DEFLECTION: ±5% of null range (±3% with voltage dials to zero).

KELVIN-VARLEY ACCURACY: ±0.002% of setting from 1/11 of full scale to full scale. Ratio stability of decade resistors, 10 ppm/year.

RECORDER OUTPUT: Adjustable from 0 to at least -20 mv for full scale right deflection and from 0 to at least -20 mv for full scale left deflection.

POLARITY: Front panel switch selects +DC, -DC, and AC.

WARMUP TIME: DC-15 seconds; AC-1 minute.

COMMON MODE REJECTION: 130 db at dc; 85 db at 60 cps; 70 db at 400 cps. Up to 1000 vdc may be applied between common and ground posts without damage. NOTE: Battery operation of Model 883AB provides complete isolation from power system ground, for elimination of errors due to ground loops.

OPERATING TEMPERATURE RANGE: Within DC specifications from 55° F to 95° F (13° C to 35° C), derated at 0.0004%/° F (0.0007%/° C) outside these limits to 32° F and 122° F (0° C and 50° C).

Within AC specifications from 55° F to 95° F (13° C to 35° C), derated outside these limits to 32° F and 122° F (0° C and 50° C) as follows:

±0.002%/° F (±0.004%/° C) up to 10KC
±0.004%/° F (±0.008%/° C) above 10KC

STORAGE TEMPERATURE RANGE: Model 883A, -40° F to +158° F (-40° C to +70° C); Model 883AB, -40° F to +140° F (-40° C to +60° C).

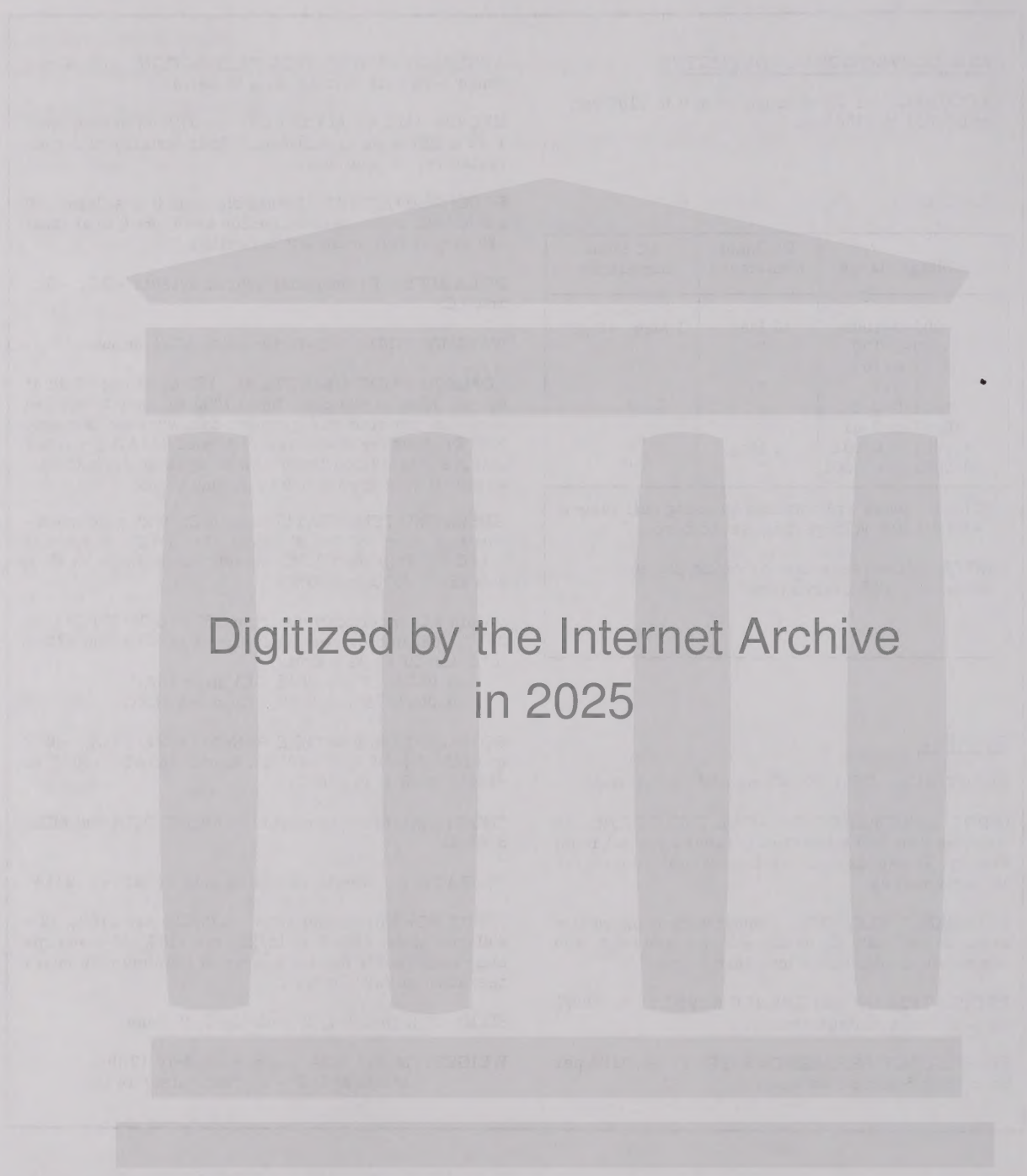
SHOCK: Meets requirements of MIL-T-945A and MIL-S-901B.

VIBRATION: Meets requirements of MIL-T-945A.

INPUT POWER: Model 883A - 115/230 vac ±10%, 50 - 440 cps; Model 883AB - 115/230 vac ±10%, 50 - 440 cps and rechargeable battery operation (minimum 30 hours operation on full charge).

SIZE: 7" high x 8-1/2" wide 14-3/4" deep.

WEIGHT: Model 883A - approximately 13 lbs.
Model 883AB - approximately 14 lbs.



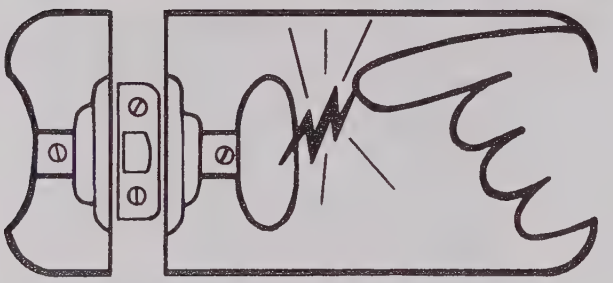
Digitized by the Internet Archive
in 2025

https://archive.org/details/manualsplus_10654

static awareness

A Message From

John Fluke Mfg. Co., Inc.

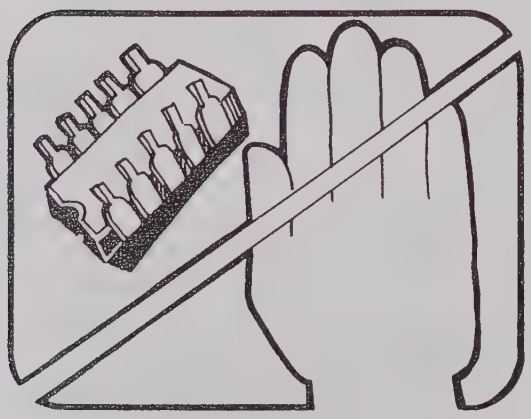


Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

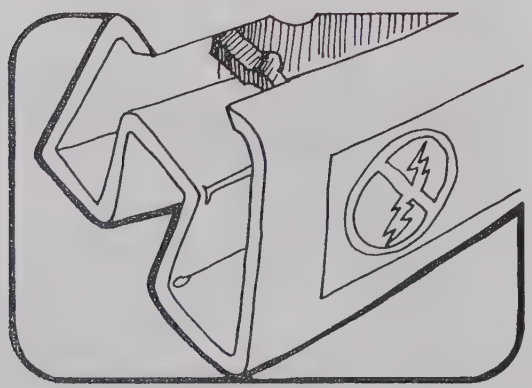
1. Knowing that there is a problem.
2. Learning the guidelines for handling them.
3. Using the procedures, and packaging and bench techniques that are recommended.

The Static Sensitive (S.S.) devices are identified in the Fluke technical manual parts list with the symbol "⊗"

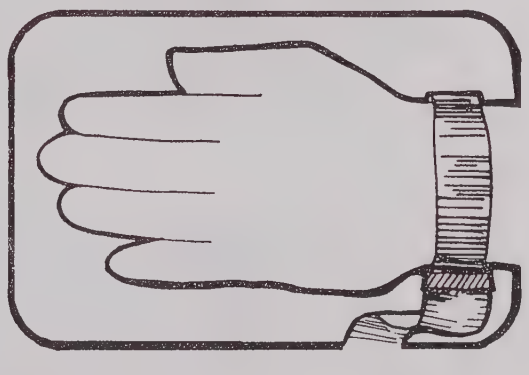
The following practices should be followed to minimize damage to S.S. devices.



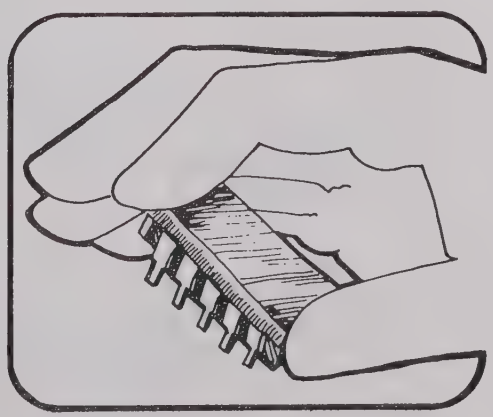
1. MINIMIZE HANDLING



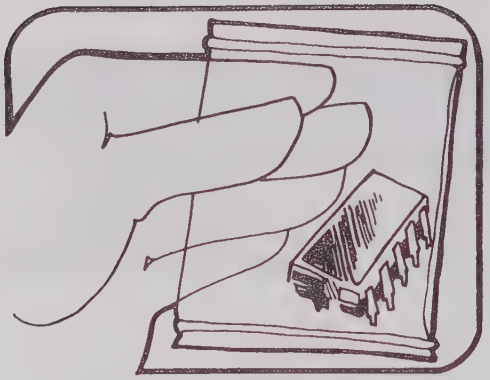
2. KEEP PARTS IN ORIGINAL CONTAINERS UNTIL READY FOR USE.



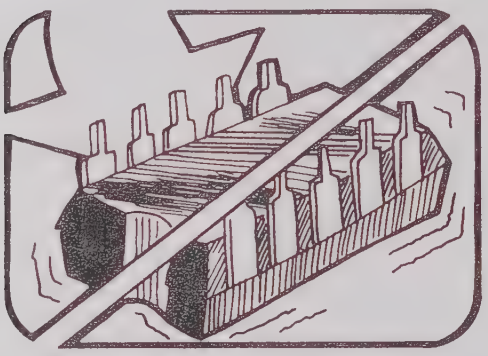
3. DISCHARGE PERSONAL STATIC BEFORE HANDLING DEVICES



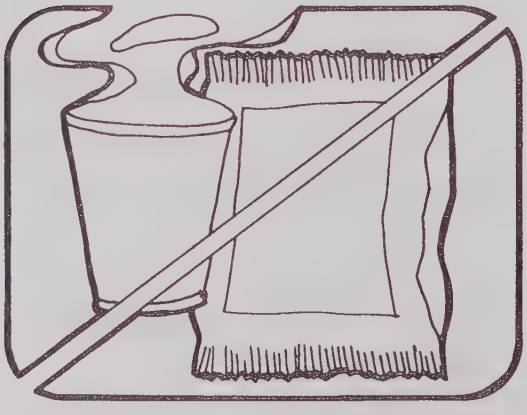
4. HANDLE S.S. DEVICES BY THE BODY



5. USE ANTI-STATIC CONTAINERS FOR HANDLING AND TRANSPORT



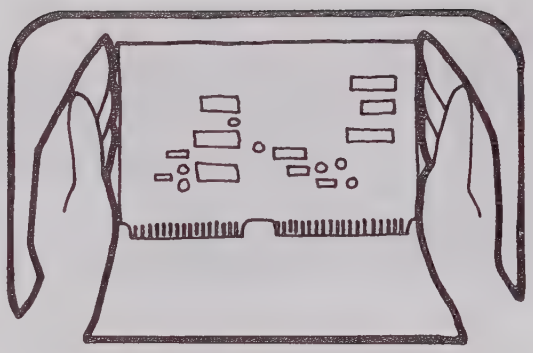
6. DO NOT SLIDE S.S. DEVICES OVER ANY SURFACE



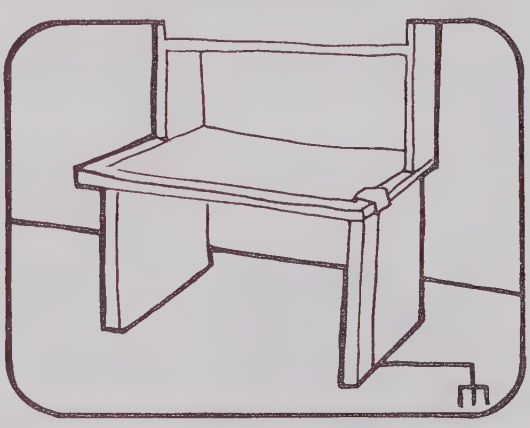
7. AVOID PLASTIC, VINYL AND STYROFOAM® IN WORK AREA

PORTIONS REPRINTED
WITH PERMISSION FROM TEKTRONIX, INC.
AND GENERAL DYNAMICS, POMONA DIV.

® Dow Chemical



8. WHEN REMOVING PLUG-IN ASSEMBLIES, HANDLE ONLY BY NON-CONDUCTIVE EDGES AND NEVER TOUCH OPEN EDGE CONNECTOR EXCEPT AT STATIC-FREE WORK STATION. PLACING SHORTING STRIPS ON EDGE CONNECTOR USUALLY PROVIDES COMPLETE PROTECTION TO INSTALLED SS DEVICES.



9. HANDLE S.S. DEVICES ONLY AT A STATIC-FREE WORK STATION
10. ONLY ANTI-STATIC TYPE SOLDER-SUCKERS SHOULD BE USED.
11. ONLY GROUNDED TIP SOLDERING IRONS SHOULD BE USED.

Anti-static bags, for storing S.S. devices or pcbs with these devices on them, can be ordered from the John Fluke Mfg. Co., Inc.. See section 5 in any Fluke technical manual for ordering instructions. Use the following part numbers when ordering these special bags.

John Fluke Part No.	Description
453522	6" X 8" Bag
453530	8" X 12" Bag
453548	16" X 24" Bag
454025	12" X 15" Bag
Pink Poly Sheet	Wrist Strap
30"x60"x60 Mil	P/N TL6-60
P/N RC-AS-1200	$7.00
$20.00	

J0089B-07U7810/SE EN Litho in U.S.A.

SECTION II

OPERATING INSTRUCTIONS

2-1. FUNCTION OF EXTERNAL CONTROLS, TERMINALS AND INDICATORS

2-2. The location, circuit symbol, and a functional description of the external controls, terminals, and indicators on the 883A and 883AB Precision Differential DC Voltmeter may be found in figure 2-1 and 2-2.

2-3. PRELIMINARY OPERATION FOR 883A

2-4. The following procedure prepares the Model 883A for operation.

a. Connect power plug to a 115 volt ac power outlet. If instrument has been wired for 230 volt operation, connect to 230 volts ac.

WARNING

The round pin on polarized three-prong plug connects instrument case to power system ground. Use a three-to-two pin adapter when connecting to a two-contact receptacle. For personnel safety, connect short green lead to a good earth ground.

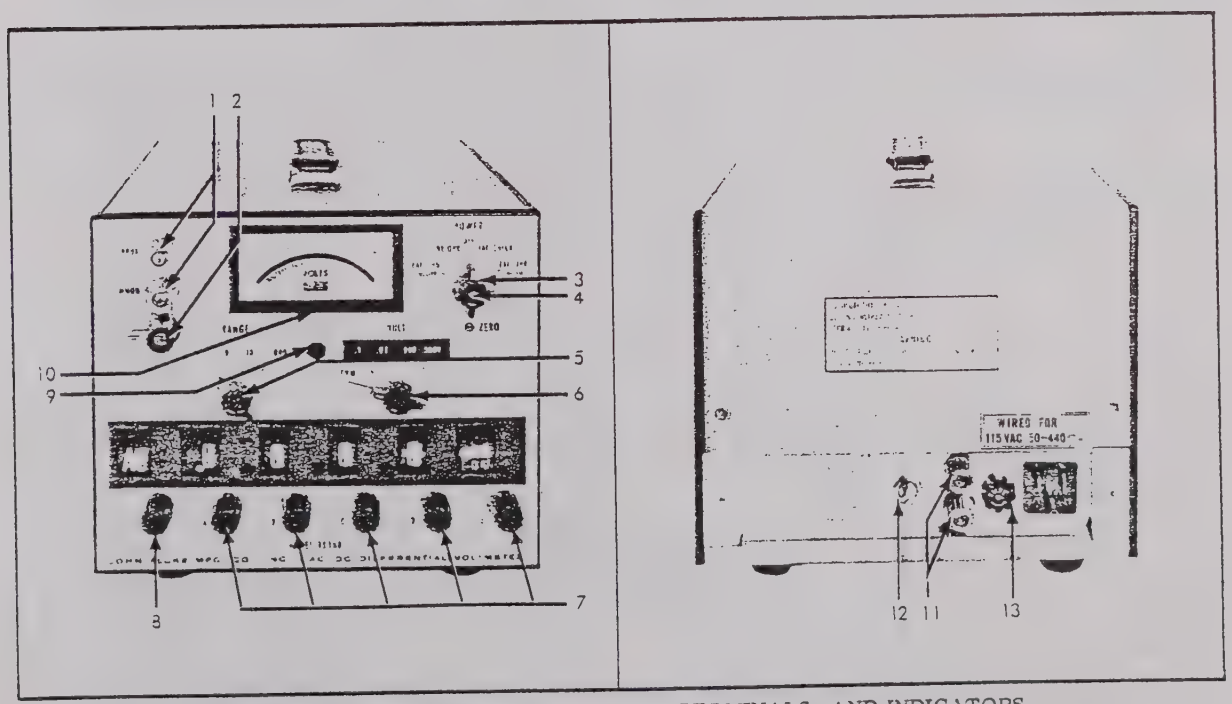


Figure 2-1. LOCATION OF CONTROLS, TERMINALS, AND INDICATORS

INDEX NO.	CONTROLS TERMINALS AND INDICATORS	CIRCUIT SYMBOL	FUNCTIONAL DESCRIPTION
1	INPUT and COMMON terminals	J1, J2	Provided for connecting ac or dc voltage to be measured.
2	Chassis ground terminal	J3	Provided for grounding purposes. A 0.01 uf capacitor is connected from the COMMON binding post to the chassis ground post. The INPUT post should never be connected to the chassis ground post. Since the instrument is equipped with a three-wire line cord with the third wire fastened to the chassis, the circuit should be checked for conflicts in grounding before connecting COMMON binding post to the chassis post.
3	POWER switch	S1	In the Model 883A, the POWER switch applies ac line voltage to primary circuit of transformer when turned from OFF to ON. In the Model 883AB, positions for OFF, BAT CHECK, and three modes of operation (LINE OPR, BAT CHG - LINE OPR, and BAT OPR - LINE ISOL) are available. When set to LINE OPR, ac line voltage is applied to primary circuit of transformer. When set to BAT CHG - LINE OPR, ac line voltage is applied to primary of transformer and batteries are charged at the same time. When set to BAT OPR - LINE ISOL, battery power is applied to the instrument and both sides of primary circuit are open. When set to BAT CHECK, battery power is applied to the instrument, both sides of primary circuit are open, and meter is connected in series with a resistor to measure voltage between reference supply batteries and reference supply output which indicates the condition of the batteries.
4	Electronic ZERO control	R239	A screwdriver adjustment used to zero null detector in the .0001 volt null mode on the 1 volt range and in the .01 volt null mode on the 100 volt range. For best results, input should be shorted prior to zeroing.
5	RANGE switch	S2	Selects desired voltage range, changes null ranges appearing in NULL window, and positions decimal point for voltage readout dials. Voltage ranges of 1, 10, 100, and 1000 volts are available. A voltage 10% higher than range setting may be measured in each range.
6	NULL switch	S3	Set to TVM for determining the approximate value of unknown voltage prior to differential measurements. Seven null voltage ranges (four of which are used for each setting of the RANGE switch) of 100, 10, 1, 0.1, 0.01, 0.001, and 0.0001 volts are used for differential measurements. These ranges represent full scale differences between the unknown voltage and the amount of precision internal reference voltage that is set on the voltage readout dials.
7	A, B, C, D, and E voltage readout dials	S5, S6, S7, S8, R13	Provide an in-line readout of the amount of internal reference voltage necessary to null the unknown voltage.
8	AC-DC polarity switch	S4	Selects the AC, + (dc), or - (dc) mode of operation. With this switch in the positive position, the polarity of INPUT binding post is positive with respect to COMMON binding post.

Figure 2-2. DESCRIPTION OF CONTROLS, TERMINALS, AND INDICATORS (Sheet 1 of 2)

INDEX NO.	CONTROLS TERMINALS AND INDICATORS	CIRCUIT SYMBOL	FUNCTIONAL DESCRIPTION
9	Mechanical zero control	None	Sets meter to zero mechanically. This adjustment should be used only after instrument has been turned off for at least three minutes or when the internal meter terminals have been shorted.
10	Meter	M1	Indicates approximate voltage when 883A is in TVM mode and difference between unknown and internal reference voltage when 883A is in differential mode.
11	RECORDER OUTPUT terminals	J4, J5	Provided for attaching a recorder to monitor voltage excursions.
12	AMP ADJ control	R8	Varies the output level of the output binding post from 0 to at least 20 millivolts at full scale deflection.
13	Fuse	F1	Fuse holder protrudes from instrument to provide easy access to the fuse. The fuse is a 1/16 ampere slow blowing type for 115 volt operation and a 1/32 ampere slow blowing type for 230 volt operation.

Figure 2-2. DESCRIPTION OF CONTROLS, TERMINALS, AND INDICATORS (Sheet 2 of 2)

b. Set switches on 883A voltmeter as follows:

RANGE	1000
NULL	TVM
ac-dc polarity	- (positive)
all voltage readout dials	0 (zero)
POWER	ON

2-5. PRELIMINARY OPERATION FOR 883AB

2-6. The following procedure prepares the Model 883AB for operation.

a. For line operation, connect power plug to a 115 volt ac power outlet. If instrument has been wired for 230 volt operation, connect to 230 volts ac.

WARNING

The round pin on polarized three-prong plug connects instrument case to power system ground. Use a three-to-two pin adapter when connecting to a two-contact receptacle. For personnel safety, connect short green lead to a good earth ground.

b. For line operation, set POWER switch to LINE OPR.

c. For battery operation, set POWER switch to BAT CHECK. Meter needle should deflect to BATTERY OK region. If meter needle does not stay within BATTERY OK region for 10 seconds, charge batteries as outlined in paragraph 2-9. If batteries are charged, set POWER switch to BAT OPR-LINE ISOL.

d. Set switches on 883AB voltmeter as follows:

RANGE	1000
NULL	TVM
ac-dc polarity	+ (positive)
all voltage readout dials	0 (zero)

2-7. ZEROING INSTRUCTIONS

2-8. From time to time, it may be necessary to adjust the electronic meter zero control. This will normally be done at somewhat more frequent intervals than complete instrument calibration. Proceed as follows:

a. Perform preliminary operation as stated in paragraph 2-3 or 2-5.

b. Mechanically zero the meter with the adjustment screw on the front of the meter case. If the instrument is in the case, it must be shut off for at least three minutes prior to this adjustment. If out of case, another method would be to short out the internal panel meter terminals prior to zeroing.

c. Turn instrument on and allow a 5 minute warmup period.

d. Set RANGE switch to 1, voltage readout dials to zero, and NULL switch to 0.0001.

e. Short INPUT post to COMMON post and adjust electronic ZERO control with a screwdriver for zero meter deflection.

f. Remove short from between INPUT and COMMON post.

2-9. BATTERY CHARGING

a. Connect power plug to a 115 volt ac power outlet. If instrument has been wired for 230 volt operation, connect to 230 volts ac.

b. Set POWER switch to BAT CHG-LINE OPR. After 16 hours, batteries will be fully charged and capable of operating the instrument for at least 30 hours. While

the batteries are being charged, the instrument may be operated the same as for line operation.

CAUTION

Since overcharging decreases battery life, it is recommended that the batteries be charged for less than 48 hours and never more than 1 week. When used properly, the batteries will give more than 200 charge-discharge cycles of operation.

2-10. OPERATION AS A DC DIFFERENTIAL VOLTMETER

a. Perform preliminary operation as stated in paragraph 2-3 or 2-5.
b. Connect unknown voltage between INPUT and COMMON post.
c. Turn RANGE switch to lowest range that will allow an on-scale reading and note approximate value of unknown voltage as indicated on meter scale.
d. If meter reads to left, turn ac-dc polarity switch to negative position. The meter needle will deflect to right. This is because polarity of unknown voltage is negative.
e. Noting position of decimal point, set five voltage readout dials to approximate voltage determined in step c. For example, if voltage is approximately 35 volts, decimal point will be between B and C voltage readout dials. Therefore, set A dial to 3 and B dial to 5.
f. Set NULL switch from TVM to successively more sensitive null ranges and adjust voltage readout dials for zero meter deflection in each null position. When meter needle indicates to the right, magnitude of voltage under measurement is greater than voltage set on voltage readout dials. When indication is to the left, voltage is less than that set on readout dials.
g. Read unknown voltage directly from five voltage readout dials.

2-11. OPERATION AS AN AC DIFFERENTIAL VOLTMETER

a. Perform preliminary operation as stated in paragraph 2-3 or 2-5.
b. Set ac-dc polarity switch to AC.
c. Connect unknown ac voltage between INPUT and COMMON posts. If one side is grounded, always connect it to the COMMON post.
d. Turn RANGE switch to lowest range that will allow an on-scale reading and note approximate value of unknown voltage as indicated on meter scale.
e. Noting the position of the decimal point, set five voltage readout dials to approximate voltage determined in step d. For example, if the voltage is approximately 35 volts, the decimal point will be between the B and C voltage readout dials. Therefore, set A dial to 3 and B dial to 5.
f. Set NULL switch to successively more sensitive null ranges and adjust voltage readout dials for zero meter deflection in each null position. When meter needle indicates to the right, magnitude of voltage under measurement is greater than voltage set on voltage readout dials. When indication is to the left, voltage is less than that set on readout dials.
g. Read unknown voltage directly from the five voltage readout dials.

2-12. OPERATION AS A CONVENTIONAL VOLTMETER

2-13. If it is desired to use the instrument as a conventional 3% voltmeter only, additional ranges can be made available by converting the NULL ranges to conventional voltmeter ranges. This is made possible by setting the voltage readout dials to zero. Proceed as follows:

a. Perform preliminary operation as stated in paragraph 2-3 or 2-5.
b. Consult figure 2-3, and select full scale voltage deflection desired. If approximate value of voltage to be measured is unknown, select the 1000 volt range initially.
c. Set ac-dc POLARITY switch, RANGE switch, NULL switch, and voltage dials as indicated for the range selected.
d. Connect voltage to be measured between INPUT and COMMON posts. If one side is grounded, always connect it to the COMMON post.
e. Read voltage from meter scale. Deflection to right indicates an unknown dc voltage is of positive polarity. An unknown ac voltage will always deflect to the right.

FULL-SCALE DEFLECTION	AC-DC POLARITY SWITCH	RANGE SWITCH	NULL SWITCH	VOLTAGE DIALS
DC:				
1000-0-1000	-	1000	TVM	No effect
100-0-100	-	100	TVM	No effect
10-0-10	-	10	TVM	No effect
1-0-1	-	1	TVM	No effect
0.1-0-0.1	-	1	0.1	All zero
0.01-0-0.01	-	1	0.01	All zero
0.001-0-0.001	-	1	0.001	All zero
0.0001-0-0.0001	-	1	0.0001	All zero
AC:				
0-1000	AC	1000	TVM	No effect
0-100	AC	100	TVM	No effect
0-10	AC	10	TVM	No effect
0-1	AC	1	TVM	No effect
0-0.1	AC	1	0.1	All zero
0-0.01	AC	1	0.01	All zero
0-0.001	AC	1	0.001	All zero

Figure 2-3. TVM RANGES

2-14. MEASUREMENT OF VOLTAGE EXCURSIONS ABOUT A NOMINAL VALUE

a. Perform preliminary operation as stated in paragraph 2-3 or 2-5.
b. Set ac-dc polarity switch to desired position.
c. Connect voltage to be observed between INPUT and COMMON posts. If one side is grounded, always connect it to the COMMON post. Deflection to the left indicates the voltage being measured is negative dc; set polarity switch to the negative position in this case. This will cause meter pointer to deflect to the right.
d. Set RANGE switch to lowest range which will give an on-scale meter indication and note nominal value of voltage indicated.
e. Set five voltage readout dials to nominal voltage.

f. Turn NULL switch to lowest position that will allow voltage excursions to remain on scale.

g. Read voltage excursions from meter. Note that full scale right and left meter deflections are equal to the NULL range setting (disregarding 10% over-range at end of scale). Meter deflection to the right indicates that magnitude of voltage under observation has increased above the nominal value while deflection to the left indicates it has decreased.

2-15. RECORDING VOLTAGE EXCURSIONS

2-16. Recorder output binding posts and an output level control are provided on the 883A and 883AB for monitoring the excursions of an unknown voltage from the voltage indicated by the voltage readout dial settings. If the leakage resistance between the recorder and ground is less than 10,000 megohms, the accuracy of the voltmeter will be impaired. Therefore, the FLUKE Model A88 Isolation Amplifier is recommended for this application. The A88 will allow the use of a wide range of strip chart recorders for recording the voltmeter reading without regard to the input isolation characteristics of the recorder.

2-17. USE OF 883A WITH AN A88 ISOLATION AMPLIFIER AND A RECORDER

2-18. To use the A88 Isolation Amplifier and a recorder with the 883A or 883AB, proceed as follows:

a. Set A88 POWER switch to ON.

b. When batteries are being used as a power source for A88, measure voltage at BATT TEST jacks. If voltage is between 11.7 and 14 volts DC, the batteries are satisfactory for use. However, if battery voltage is below 12.8 volts, batteries are approaching end of their useful life and should be replaced.

c. Connect RECORDER OUTPUT terminals of differential voltmeter to INPUT terminals of isolation amplifier with teflon leads.

d. Connect OUTPUT terminals of isolation amplifier to recorder input terminals.

e. Perform preliminary operation as stated in paragraph 2-3 or 2-5.

f. Short INPUT post to COMMON post and set switches on voltmeter as follows:

RANGE	10
NULL	1
voltage readout dials	1.00000

The meter will indicate full scale (-1.0). This provides up to a maximum of at least 20 millivolts at RECORDER OUTPUT terminals depending on setting of AMP ADJ control.

g. Turn on recorder and set recorder gain so that a recorder input of either ±2 volts or near maximum if maximum is below ±2 volts, will cause recorder deflection desired for full scale deflection of differential voltmeter.

h. Adjust AMP ADJ control on rear of differential voltmeter until recorder deflection obtained is that desired to correspond to full scale deflection of the differential voltmeter.

i. Remove short from INPUT to COMMON post. The voltmeter and recorder are now ready for recording the measurement of voltage excursions about a nominal value. Proceed as instructed under paragraph 2-14.

2-19. USE OF 883A WITH A RECORDER

2-20. To use a recorder with the 883A or 883AB proceed as follows:

a. Connect RECORDER OUTPUT terminals of differential voltmeter to input terminals of recorder with teflon leads.

NOTE

Do not ground either of the voltmeter RECORDER OUTPUT terminals or either of the recorder input terminals. If any of these terminals are grounded, current will be drawn from the Kelvin-Varley divider and the voltmeter will no longer be accurate.

b. Perform preliminary operation as stated in paragraph 2-3 or 2-5.

c. Check for excessive electrical leakage as follows:

(1) Connect a voltage to the input of the 883A and differentially measure its potential in the most sensitive null range.

(2) Alternately connect and disconnect the recorder leads from the output terminals of the 883A while noting the meter needle deflection. More than one major scale division deflection (10% of null range) indicates that excessive leakage has been introduced by the recorder. This will impair the accuracy of the 883A voltmeter.

(3) Disconnect the voltage.

d. Short INPUT post to COMMON post and set switches on voltmeter as follows:

RANGE	10
NULL	1
voltage readout dials	1.00000

The meter will indicate full scale (-1.0). This provides up to a maximum of at least 20 millivolts at RECORDER OUTPUT terminals depending on setting of AMP ADJ control.

e. Adjust AMP ADJ control until recorder deflection obtained is that desired to correspond to full scale deflection of the voltmeter.

f. Remove short from INPUT to COMMON post. The voltmeter and recorder are now ready for recording the measurement of voltage excursions about a nominal value. Proceed as instructed under paragraph 2-14.

2-21. MEASUREMENT OF HIGH RESISTANCE

2-22. One of the features of the 883A voltmeter is its ability to be used as a megohmmeter for rapid measurements of high resistance from 10 megohms to 11,000 megohms with a typical accuracy of 5%. The following

equation may be used to compute the resistance in megohms of an unknown connected to the input binding posts when the RANGE switch is set to 10:

$$R_x = R_i \left(\frac{E}{E_m} - 1\right) \text{ megohms}$$

where:

R_x is the unknown resistance in megohms.

E is the voltage indicated by the voltage readout dials.

E_m is the oltage indicated on the meter.

R_i is the input resistance of the TVM circuit in megohms. 10 for the 1 and 0.1 null range and 1 for the 0.01 and 0.001 null range on the 10 volt range.

2-23. For rapid measurement of resistance between 10 megohms and 11,000 megohms, proceed as follows:

a. Perform preliminary operation, paragraph 2-3 or 2-5.
b. Set RANGE switch to 10 and NULL switch to 1.
c. Connect unknown resistance between INPUT post and COMMON post. Use short isolated leads to prevent measurement of leakage resistance between leads.
d. Adjust voltage readout dials for full scale meter deflection (-1.0). If full scale deflection cannot be obtained with NULL switch set to 1, set NULL switch to 0.1 or 0.001.
e. Determine value of unknown resistance from figure 2-4.

Range of Unknown Resistance	Null Switch Position	To Obtain Value Of Unknown In Megohms When Meter Indicates Full Scale
10 MΩ to 100 MΩ	1	Multiply amount set on voltage readout dials by 10 and subtract 10.
90 MΩ to 1090 MΩ	0.1	Multiply amount set on voltage readout dials by 100 and subtract 10.
1,000 MΩ to 11,000 MΩ	0.001	Multiply amount set on voltage readout dials by 1000.

Figure 2-4. RESISTANCE MEASUREMENTS

2-24. NOTES ON MEASURING AC OR DC VOLTAGES

2-25. GROUND LOOP PRECAUTIONS

2-26. Ground loop currents should be avoided to assure accuracy when making measurements. Potential differences are often found at different points on power system grounds. When this is the case, current may flow from the power system ground through the 883A and the equipment under measurement and back to the power system ground. To avoid this when system being measured is grounded, do not connect 883A COMMON binding post to chassis ground post.

2-27. USE OF SHORTING LINK

2-28. A 0.01 uf capacitor (C1) is connected from the COMMON binding post to the chassis ground post to reduce the effect of circulating ac currents from the transformer. In some cases, it is possible for C1 to acquire a charge. For example, C1 will become charged when making common mode voltage measurements. This condition may cause an error on low level measurements (under 5 volts) due to C1 discharging through the Kelvin-Varley divider and leakage resistance to ground. Connecting the shorting link from the COMMON post to the ground post for a few seconds will discharge C1 and thus prevent an inaccurate indication.

2-29. BATTERY CHECKING

2-30. If the voltmeter is left in the battery operating mode for an extended period of time, the batteries will become discharged. When the batteries are left in a completely discharged state with the voltmeter turned off, their voltage will recover with time. It is possible that the batteries may have recovered enough for the meter to indicate they are charged when the power switch is first set to battery check. However, after a few seconds, the battery voltage will fall and the meter will indicate that the batteries need to be charged. It should also be noted that the voltage characteristic of the nickel-cadmium batteries is very flat except near full charge and complete discharge. Therefore, when the batteries are checked, the meter needle deflection will not be proportional to the remaining ampere-hour capacity of the batteries. Just after the batteries are charged, the meter needle will indicate near full scale. However, most of the time the batteries are charged, the meter needle will indicate near half scale. A few hours before the batteries need a recharge, the meter needle will indicate just within the battery ok region.

2-31. EFFECT OF COMMON MODE VOLTAGES

2-32. Common mode errors are caused by leakage currents passing through ground loops. Since great care has been taken in the design and construction to insulate the circuitry from chassis ground, accurate dc common mode measurements up to 1000 volts dc above ground can be made with the 883A and 883AB. The dc common mode rejection is at least 134 db (5,000,000 to 1) or 0.2 uv error per common-mode-volt all the way up to 70% relative humidity. However, since the leakage resistance is dependent on dampness, the dc common mode error is typically much less at lower relative humidities. Thus, common mode measurements should be made with a relative humidity below 70%. Also, if the common mode voltage is greater than 50 volts, the measurement should be made several minutes after hookup for best accuracy. This is due to the time it takes to charge stray capacities to ground through the extremely high leakage resistances.

2-33. NOTES ON MEASURING DC VOLTAGES

2-34. EFFECT OF AC COMPONENTS ON DC MEASUREMENTS

2-35. An ac component of several times the unknown dc may be present on the unknown and the 883A will always indicate well within the specifications for frequencies

over a few hundred cycles. An ac component may have an adverse effect if it is of a low frequency or if it has a frequency that is a multiple or submultiple of the chopper frequency. A triple section low pass filter (R201, C201, R202, C202, R203, and C203) is used at the input of the null detector to reduce any ac present on the dc being measured. At lower frequencies, this low pass filter is less effective and the magnitude of the ac component is more significant. If this frequency is below 100 Hertz, the accuracy may no longer be with specifications. For example, a 60 Hertz ac voltage that is 1% of the input will cause an error of approximately 0.001% which is well within the specifications. This 1000:1 rejection of ac also applies until the ac voltage is 1000 times the null range. For example, on the .01 volt null range, the ac rejection of 1000:1 applies up to 10 vac. When the frequency is very close to a multiple or submultiple of the chopper frequency (approximately 84 Hertz), the meter needle will oscillate at the difference frequency. If ac components that affect the accuracy are ever encountered, additional filtering will be required. For an ac of a single frequency, a twin-T filter is effective and has the advantage of low total series resistance. For an ac variable frequency, an ordinary low pass filter may be used. In either case, high quality capacitors of high leakage resistance should be used.

2-36. MEASUREMENT OF NEGATIVE VOLTAGES

2-37. Because of a polarity switch, voltage which are negative with respect to ground as well as the more commonly encountered positive voltages may be measured with equal facility. If the INPUT post is connected to the metal case, either at the 883A or at the source under measurement, the accuracy of the voltmeter may be reduced. However, with the polarity switch, the INPUT post never has to be connected to ground. If the unknown voltage is grounded, always connect the grounded side to the COMMON post and use the polarity switch to obtain the proper result.

2-38. NOTES ON MEASURING AC VOLTAGES

2-39. ERRORS DUE TO DISTORTION

2-40. The ac to dc converter in the 883A is an average measuring device calibrated in rms. The converter will put out a dc voltage that is proportional to 1.11 times the average value of the ac input voltage. Thus, if the input signal is not a true sinusoid, the 883A reading is probably in error because the ratio of rms to average is usually not the same in a complex wave as in a sine wave. The magnitude of the error is dependent on magnitude of the distortion and on its phase and harmonic relationship with respect to the fundamental. Figure 2-5 indicates how the accuracy will be affected by various harmonics for different percentages of distortion. If the distortion present in the signal is composed of even harmonics and is less than 2%, the error between the 883A reading and true rms is minor. A larger error can occur if the distortion is composed of odd harmonics, especially the third harmonic. Note that for 2% of third harmonic distortion the error in the reading could range from 0 to 0.687%.

Harmonic	% Distortion	% Error From True RMS*	
		Maximum Positive	Maximum Negative
Any even harmonic	0.1	0.000	0.000
	0.5	0.000	0.0001
	1.0	0.000	0.005
	2.0	0.000	0.020
Third harmonic	0.1	0.033	0.033
	0.5	0.167	0.168
	1.0	0.328	0.338
	2.0	0.667	0.687
Fifth harmonic	0.1	0.020	0.020
	0.5	0.099	0.101
	1.0	0.195	0.205
	2.0	0.380	0.420

*Error depends upon phase relationship between harmonic and fundamental, i. e. error can be any value between maximum positive and maximum negative, including zero.

Figure 2-5. PERCENT ERROR DUE TO HARMONIC DISTORTION

2-41. ERRORS DUE TO GROUNDING

2-42. In the 883A there is a 0.01 uf capacitor connected from the COMMON terminal (middle post) to chassis ground. If it is desired to make measurements where the voltage to be connected to the lower input terminal is not at ground potential, a line cord adapter must be used to isolate the 883A chassis from line ground. Otherwise, the 0.01 uf capacitor would place an ac load on the circuit being measured.

2-43. INTERNAL CONVERTER NOISE

2-44. When the instrument is shorted in the ac mode, the converter may produce a residual noise output of approximately 100 uv. This noise voltage will cause an insignificant error as long as ac input signals of 1 mv or larger are applied to the instrument. Figure 2-6 shows a typical half wave of the signal voltage at the output of the converter amplifier. It is easily seen that the noise contributes very little to the average value of the signal and is well within the 2.6% accuracy of the instrument at 1 mv. Also for input signals over 1 mv, the instrument is noise free to within 2 parts per million of the input range. For example, on the 1 volt input range the instrument will contribute less than 2 uv of noise to any measurement.

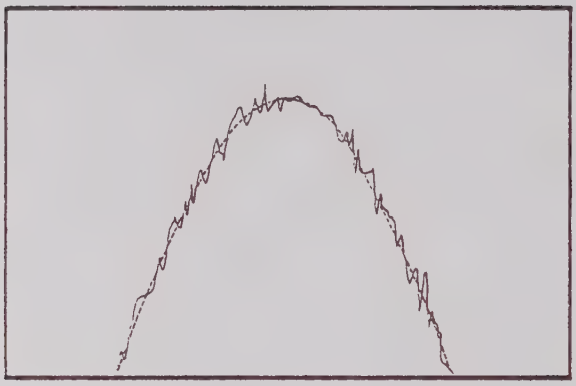


Figure 2-6. SIGNAL VOLTAGE WITH CONVERTER NOISE

2-45. MOST SENSITIVE NULL RANGE ON AC

2-46. The most sensitive null range for each input range should be used with caution when measuring ac voltages. Most ac sources are not stable enough to be used on this range. For example, if 1.0 volt is measured with the range switch set to 1 and the null switch set to 0.0001, the null detector sensitivity is 100 microvolts full scale. Since 100 uv is 0.01% of 1.0 volt, an ac source with a stability worse than ±0.01% will cause the 883A meter pointer to swing from one end of the meter scale to the other. Also, if the input is shorted with the range switch set to 1 and the null switch set to 0.0001, the meter needle may deflect more than full scale due to converter noise. However, as pointed out in paragraph 2-43, converter noise will not impair the accuracy for input signals greater than 1 mv. Thus, any excessive erratic meter needle movement is due to ac source stability.

SECTION III

THEORY OF OPERATION

3-1. INTRODUCTION

3-2. Figure 3-1 shows the block diagram for the 883A Differential Voltmeter. As seen in this figure, the circuit is mainly composed of an ac to dc converter, a dc input attenuator, a dc transistorized voltmeter (tvm), and an extremely accurate 0 to 11 volt reference. The dc input attenuator reduces the input voltage by a factor of 100 on the 1000 and 100 volt dc range. The tvm uses a null detector, an attenuator, and a meter to obtain high sensitivity. The 0 to 11 volt reference uses a range divider and a Kelvin-Varley attenuator to make the output of two well regulated zener diodes adjustable. Refer to the functional schematic following Section VI for more detail. This schematic is designed to aid in the understanding of circuit theory and troubleshooting. The signal flow is from left to right and the components are laid out in a functionally logical manner.

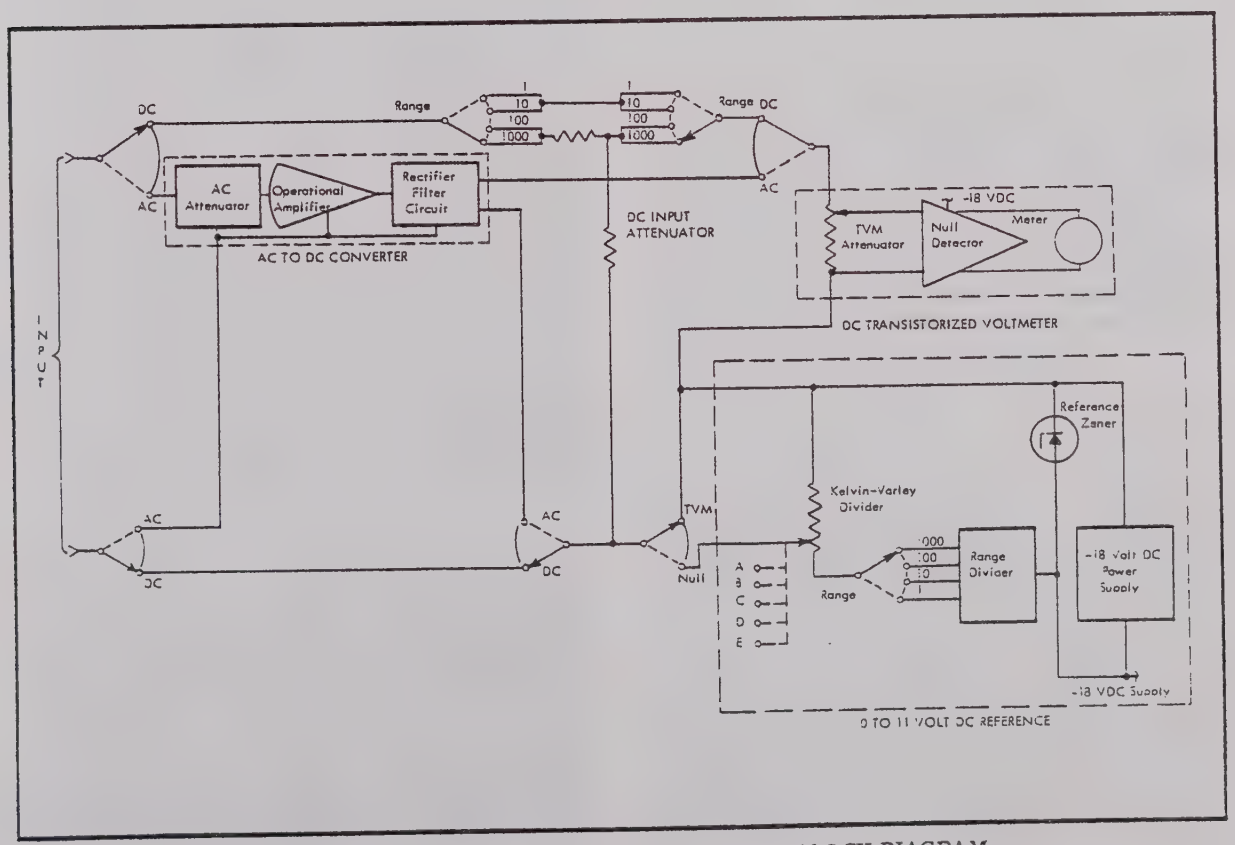


Figure 3-1. 883A DIFFERENTIAL VOLTMETER BLOCK DIAGRAM

3-3. The overall operation of the voltmeter may be summarized as follows. To measure the approximate value of a dc voltage between 0 and 11 volts, the unknown voltage is connected directly across the tvm attenuator. This attenuator is set in such a way that the maximum voltage for each range is reduced to a signal of 1 millivolt (100 microvolts for the 1 volt range in the highest null mode). The signal is then applied to the null detector and causes 100 microamperes to flow through the meter for full scale deflection. To accurately measure this dc voltage, the unknown voltage is connected across the series combination of the tvm and the 0 to 11 volt reference. The reference voltage is then adjusted with the five voltage readout dials until it matches the unknown voltage as indicated by the tvm. For voltages between 11 and 1100 volts, the dc input attenuator divides the unknown voltage by 100. The 883A then operates essentially the same as for measurements from 0 to 11 volts. All ac measurements are made by first converting the ac input voltage to a dc voltage by means of the ac to dc converter. The 883A then operates essentially the same as for approximate and accurate dc measurements.

3-4. In order to provide for a more complete understanding of the 883A voltmeter, the following paragraphs describe each section of the circuit in detail.

3-5. DC INPUT ATTENUATOR

3-6. Since the instrument contains a 0 to 11 volt reference, the unknown voltage is measured by comparing it to a known voltage with the aid of a null detector only on the 1 and 10 volt range. On the 100 and 1000 volt range, the dc input attenuator (R100 through R104) divides the unknown voltage by 100 and this attenuated voltage is then measured by the potentiometric principal. Thus, after attenuation by 100, the 100 and 1000 volt ranges are reduced to the equivalent of 1 and 10 volt ranges. The dc input attenuator is extremely accurate and has excellant long term stability. The 10K variable resistor (R103) is used during factory calibration to setup the proper division ratio. This adjustment can then be performed as required at regular calibration intervals.

3-7. DC TRANSISORIZED VOLTMETER

3-8. GENERAL

3-9. The dc tvm is composed of an attenuator, a null detector, and meter. The heart of the dc tvm is the null detector in which the dc signal is modulated by an electromechanical chopper, amplified by a five stage resistance-capacitance coupled amplifier, rectified by a transistor switch, and finally filtered to produce a dc output. The null detector has a high amount of negative current feedback. This makes the proportion of the output current feedback approximately equal to the signal voltage divided by the resistance of the feedback resistor, regardless of the amplifier characteristics. The high negative feedback also makes the amplifier relatively insensitive to the gain changes in individual transistors due to aging, and replacement. The output current from the null detector is indicated on a meter that has tautband suspension. This suspension does away with all friction associated with meter pivot stickiness. Thus, any tendency for the meter pointer to stick at one point of the scale and then jump to another point is eliminated. The tvm attenuator is used to reduce the voltage span of each range to a common range usable by the null detector to produce proper meter deflection.

3-10. NULL DETECTOR

3-11. The null detector is a current feedback amplifier that drives a meter. Any feedback amplifier is essentially a null seeking device. That is, it tends to make the voltage fed back to the input equal to the input voltage. In a current feedback amplifier, the feedback voltage is equal to the voltage drop across a fixed resistor caused by the output current or a portion of the output current. At the input to the 883A null detector R201, C201, R202, C202, R203, and C203 form a triple section low pass filter that reduces any ac component present on the dc voltage being measured. The difference between the voltage appearing at the output of the filter and the voltage developed across feedback resistor R236 is converted to an alternating voltage by G201, an 84 hertz chopper. The voltage across R236 is proportional to the current flowing in the meter. The alternating voltage created by G201 is amplified by a five-stage solid-state amplifier. The first stage is a p-channel field effect transistor (Q201). The field effect transistor provides both high impedance and low noise input characteristics. The next four stages consist of two transistor doubletons (Q202 to Q205). During one portion of the chopper cycle, the output of the amplifier is clamped to approximately null detector common potential by Q206, a transistor switch. The transistor switch is gated in synchronization with the chopper since the gating pulse comes from the voltage that is used to drive the chopper. During the other portion of the chopper cycle, the output of the amplifier is filtered by R-C filter R225-C219 to provide a dc current for the meter. A portion of the current that flows through the meter is shunted back to the 200Ω feedback resistor R236 thus completing the feedback loop. The null detector has a basic sensitivity of 1 millivolt except in the most sensitive null mode for the 1 and 100 volt range where the sensitivity is 100 microvolts. For the two most sensitive null modes in the 100 and 1000 volt range, the sensitivity is boosted 10% to compensate for the loading effect of the tvm attenuator on the dc input attenuator. The output resistance of the dc input attenuator is 100K and the input resistance of the tvm dc attenuator is 1 meg. Thus, when monitoring voltage excursions, much more accurate off null readings are obtained due to the 10% boost in null sensitivity.

3-12. TVM ATTENUATOR

3-13. In the dc tvm mode, two positions on the tvm attenuator selected by range switch section S2H provide the necessary reduction of the 1 and 10 volt ranges for proper null detector input. The same two positions on the tvm attenuator are used for the 100 and 1000 volt ranges because the input attenuator divides the input signal by 100 and thus reduces the 100 and 1000 volt ranges to the equivalent of 1 and 10 volt ranges. In the differential mode, the voltage difference (unknown voltage, or unknown voltage divided by 100, minus reference voltage) is reduced as necessary by positions on the tvm

attenuator selected by null switch sections S3H, S3G, and S3E to provide the basic null detector inputs of 1 millivolt or 100 microvolts.

3-14. In the ac tvm mode, null switch section S3H and ac-dc polarity switch section S4E provide connection to only one position on the tvm attenuator regardless of where the range switch is set. Also, in the ac differential mode, the voltage difference (converter output voltage minus reference voltage) is reduced by the same positions on the tvm attenuator as for 1 volt dc differential measurements. This is because the output of the ac-dc converter is 1 volt dc for full input on each range.

3-15. INPUT RESISTANCE

3-16. For the tvm, low sensitivity, and medium low sensitivity modes, the input resistance of the tvm attenuator is 10 megohms (R4 through R7). For the medium high and high sensitivity modes, the input resistance of the tvm attenuator is 1 megohm (R4 through R7). However, this is not the input resistance of the 883A for the dc tvm and dc differential mode. For the 1 and 10 volt range, the input resistance is determined by dividing the unknown voltage by the current drawn from the unknown. The current drawn from the unknown is equal to the difference between the unknown terminal voltage and the internally known voltage divided by the resistance of the tvm attenuator. The equation for input resistance can therefore be written as:

$$R_{in} = \frac{E_u}{I_u} = \frac{E_u R_a}{|E_u - E|} = \frac{E_s (R_a + R_s)}{|E_s - E|} - R_s$$

where:

R_{in} = input resistance of voltmeter

E_u = $E_s - I_u R_s$ = terminal voltage of unknown

I_u = current drawn from unknown

E_s = source voltage of unknown

R_s = source resistance of unknown

R_a = input resistance of tvm attenuator

E = voltage indicated by voltage readout dials

$| \ |$ = absolute value (magnitude only)

Thus, the input resistance is essentially infinite (leakage resistance across input is in the order of 10^{12} ohms) at null when E is equal to E_u and E_s. For the 100 and 1000 volt range, the dc input attenuator is always connected across the input terminals. Thus, the input resistance is equal to the resistance of the dc input attenuator which is 10 megohms.

3-17. The input impedance for the ac tvm and ac differential mode depends on the input impedance of the ac to dc converter and its attenuator. The ac input impedance is thus 1 megohm and 40 picofarads.

3-18. CHOPPER DRIVE CIRCUIT

3-19. The chopper drive circuit determines the chopper timing frequency of 84 Hz. The circuit is symmetrical with the transistors biased so that they can conduct simultaneously. However, cross-coupling capacitors C105 and C106 force Q106, Q109 and Q107, Q108 to conduct alternately. This results in a square wave varying from about 0 to 6 volts that drives chopper coil G201. The symmetry and frequency of the waveform are adjusted with R125 and R123 respectively.

3-20. NULL DETECTOR POWER SUPPLY

3-21. The voltage for null detector amplifier stages Q201 through Q205 is supplied by the same -18 volt power supply that is used to power the 0 to 11 volt reference. The voltage for chopper drive circuit transistors Q106 through Q109 is obtained from a half-wave rectifier consisting of diode CR101 and an R-C vilter network (R105 and C101) that supplies 6 volts dc. Current determining resistors R238 and R240, diodes CR201 and CR202, and divider resistor R239 provide a compensating voltage for the purpose of adjusting the null detector to zero with R239 when there is no signal input. Diode CR201 keeps one side of R239 at approximately +0.6 volt dc with respect to the null detector common while diode CR202 keeps the other side at approximately -0.6 volt dc.

3-22. EFFECT OF AC COMPONENTS ON DC MEASUREMENTS

3-23. The only ac voltage component that will reduce the accuracy of the 883A is one that either saturates the null detector or one that beats with the chopper frequency. Since the voltage required for saturation is greater than that required for beating, the null detector is most sensitive to an ac component with a frequency that is a submultiple or a low multiple of the chopper frequency. However, this is easy to detect because the meter will beat at the difference frequency. The low pass filter at the input of the chopper-amplifier will attenuate any ac component. The magnitude of the ac voltage appearing at the output of the filter depends on both its amplitude and frequency before filtering. For all practical purposes, one should never encounter any trouble above a hundred cycles. Below this, the filter may not attenuate the ac component enough. However, this is not as bad as it appears. A 60 cycle ac voltage that is 1% of the input voltage will cause an error of approximately 0.001% which is well within specifications. If ac components that affect accuracy are ever encountered, additional filtering as set forth in the operating instructions will eliminate the problem.

3-24. TVM GAIN AND ZERO ADJUSTMENTS

3-25. Variable resistor R239 in the feedback network provides a means of adjusting the output current of the null detector to zero when there is no input signal. The gain of the null detector is adjusted by means of R230 in the feedback network for the 1 millivolt sensitivity and by means of R231 for the 100 microvolt sensitivity.

3-26. RECORDER OUTPUT

3-27. The recorder output is picked off divider string R226, R8, and R227. Recorder output AMP ADJ control R8 provides a means of adjusting the output voltage up to a maximum of at least 20 millivolts at full scale deflection (disregarding 10% over-range at end of scale). The voltage at the RECORDER OUTPUT terminals is proportional to the meter reading.

3-28. 0 TO 11 VOLT REFERENCE

3-29. GENERAL

3-30. When the 883A is used to make differential dc voltage measurements between 0 and 11 volts, an internal voltage is nulled or matched against the unknown voltage. An extremely accurate reference is therefore required. This is obtained from the 0 to 11 volt reference. The 0 to 11 volt reference is composed of a well regulated -18 volt power supply, a range divider, and a five decade Kelvin-Varley divider. The range divider reduces the voltage from a pair of stable Zener diodes in the -18 volt reference supply to 11 volts for the 10 and 1000 volt dc ranges and to 1.1 volts for the 1 and 100 volt dc ranges before it is applied to the Kelvin-Varley divider. The Kelvin-Varley divider divides its input voltage (11 or 1.1 volts) into over 1,100,000 equal increments any number of which may be selected by setting the five decades with the five voltage readout dials. The output of the Kelvin-Varley divider, therefore, provides an extremely accurate reference voltage.

3-31. -18 VOLT POWER SUPPLY

3-32. The -18 volt power supply uses a diode (CR102) and a filter network (R106 and C102) to supply unregulated dc voltage to series passing transistor Q101. In the Model 883AB, unregulated dc is supplied directly from a set of two batteries (BT3) in the BAT CHECK and BAT OPR modes. The voltage is regulated by comparing a sample of the output voltage tapped off a divider string (R108, R109, and R110) with the voltage from Zener reference diodes CR103 and CR104 in differential amplifier Q102 - Q103. The output of Q102 - Q103 is fed to differential amplifier Q104 - Q105 which drives the base of series pass transistor Q101. The control action of the differential amplifiers continuously adjusts the voltage drop across the series pass transistor so as to keep the sample voltage equal to the voltage of the Zener reference diodes. Any difference in voltage, the error, is amplified by Q102 - Q103 and Q104 - Q105 and thus changes the voltage drop across Q101 to maintain the output at -18 volts. The -18 volt output is used to provide operating voltages for the null detector and, with the aid of current determining resistors R115 and R116, to supply an extremely constant current to its own Zener reference diodes CR103 and CR104. The voltage across the two Zener diodes may be anywhere between approximately 11.4 and 13 volts. However, this voltage has a stability of better than ±15 ppm per year and an overall temperature coefficient of less than 2 ppm per °C.

3-33. RANGE DIVIDER

3-34. In the 1000 and 10 volt dc range, the Zener reference diode voltage is connected directly to the Kelvin-Varley divider through resistors R118 and R119 by means of range switch sections S2J and S2I. The voltage drop across R118 and R119 reduces the Zener reference voltage to 11 volts at the input of the Kelvin-Varley divider. In the 100 and 1 volt dc range, range resistors (R120, R121, and R122) selected by range switch sections S2J and S2I reduce the voltage to 1.1 volts at the input to the Kelvin-Varley divider. With the ac-dc switch set to AC, ac-dc switch section S4H provides connection to the range resistors that divide the reference voltage to 1.1 volts. This 1.1 volts is then passed to the Kelvin-Varley divider by ac-dc switch section S4G. The voltage applied to the Kelvin-Varley divider is always 1.1 volts for ac because the maximum output of the ac to dc converter is always 1.1 volts.

3-35. KELVIN-VARLEY DIVIDER

3-36. The five Kelvin-Varley decades composed of resistors R13 and R302 to R364, and associated voltage dials A through E provide a means of making the two precision voltages (11 and 1.1 volts) adjustable. The first decade has twelve 5K resistors (a 4,999.2 ohm resistor and a 2 ohm trimmer). Two of these resistors are shunted by the 10K total resistance of the second decade. Between the two wipers of S5 (voltage dial A) then, there is a total resistance of 5K (10K paralleled by 10K). Thus, the first decade divides the voltage across it into eleven equal parts with one of the equal parts appearing across the two shunted resistors. Similarly, the second, third, and fourth decades divide the voltage across them into ten equal parts. Note that the second, third, and fourth decades each have eleven 1K resistors. The resistors may have the same value because padding resistors R328 - R329 and R315 - R316 are used across the third and fourth decades respectively to keep the proper resistance matching. The last decade, with its associated shunt resistors to keep the proper matching, is a variable resistor which can be set to pick off increments equal to less than 1/100 times the voltage across its input. The Kelvin-Varley resistors are matched for both temperature coefficient and tolerance thus providing an overall accuracy of 0.002% absolute from 1/11 of full scale to full scale. With the null switch in any null range, the output of the Kelvin-Varley divider is connected in series with the tvm attenuator thus providing the accurate 0 to 11 volt or 0 to 1.1 volt reference voltage required.

3-37. ADJUSTMENTS

3-38. Variable resistor R110 is used during final factory calibration to set the reference supply to -18 volts. This adjustment is not exceedingly critical and should have to be done only when a component of the reference supply has been replaced. The voltage from the Zener reference diodes is reduced to 11 volts at the input to the Kelvin-Varley divider by adjusting variable resistor R119 during calibration. Range-divider variable resistor R121 may then be adjusted for 1.1 volts at the input to the Kelvin-Varley divider. The 2 ohm trimmer resistors (even resistors from R342 to R364) and variable padding resistors R329, R316, and R303 should require adjustment only after a component of the Kelvin-Varley divider has been replaced.

3-39. AC TO DC CONVERTER

3-40. GENERAL

3-41. The ac to dc converter is composed of an attenuator, an operational amplifier, and a rectifier-filter circuit. A pair of diodes in the rectifier-filter circuit are used to convert the unknown ac into pulsating dc. This pulsating dc is then filtered to obtain a dc voltage that is proportional to the average value of the ac input voltage. The output, however, is calibrated to indicate the rms value of a pure sine wave. An operational amplifier with high negative feedback is used to make the rectification characteristics of the diodes linear and stable. The first stage is an n-channel field effect transistor (Q501). The field-effect transistor provides both high impedance and low noise input characteristics. The next four stages consist of two transistor doubletons (Q502, Q503, Q504, and Q506). Transistor Q505 acts as a dynamic load and thus increases the output impedance of the amplifier. The amplifier achieves a midband loop gain of approximately 70 db with a virtually flat frequency response from 20 Hz to 20 kHz. At the output of the amplifier, full wave rectification is used to return negative feedback to the gate of the field-effect transistor. The high negative feedback makes the amplifier practically noise free and relatively insensitive to gain changes in individual stages due to aging and transistor replacement. An attenuator is used to reduce the ac input voltage on the higher ranges to within the operating level of the converter amplifier.

3-42. CONVERTER POWER SUPPLY

3-43. The auxiliary power supply for the converter is composed of Q507, Q508, Q509, and the associated components. Diode CR505 and filter network R534-C519 supply unregulated dc voltage to series pass transistor Q507. In the 883AB, unregulated dc voltage is supplied from a set of batteries, BT2, in the BAT CHECK and BAT OPR modes. The emitter voltage of Q509 is set by Zener diode CR506. The base input to Q509 is taken from a divider string, R538, R539, and R540, which samples the output voltage of the +18 volt supply. Any variation in the +18 volts varies the base drive of Q509, which varies the output from the collector load of Q509. Since the output of Q509 drives Q508, the collector current of Q508 continuously adjusts the conductance of Q507 to maintain the auxiliary voltage constant at the value determined by the setting of R539.

3-44. OPERATION

3-45. All ac measurements are made by first converting the ac input voltage into a dc voltage. The converter provides a dc output of 1 volt when full range voltage is applied to the 883A in each ac range. In the 1 volt ac range, the ac-dc polarity switch and the range switch connect the input binding posts directly to the converter input. The converter gain is of such a value that the dc output voltage is equal to the rms value of the converter input voltage for a sine wave. For the 1000, 100, and 10 volt ac ranges, a separate input attenuator for each range reduces the unknown ac voltage by a factor of 1000, 100, and 10 respectively. The operation of the converter is then the same as for the 1 volt range. Thus, an output of 1 volt dc is provided for full range input of a pure sine wave on any ac range.

3-46. ADJUSTMENTS

3-47. The converter gain is adjusted with R503 in the feedback loop of the operational amplifier. Capacitor C502 in the feedback loop is used to adjust the high frequency response of the converter. The attenuation of the 1000, 100, and 10 volt attenuators are adjusted with R410, R406, and R403 respectively. Capacitors C405, C403, and C401 are used to adjust the high frequency response attenuators. The bias of field-effect transistor Q501 should require adjustment with R508 only when Q501 or a component in its drain-source circuit is replaced. The amplifier output level at the collector of Q506 should require adjustment with R522 only if Q505, Q506, or a component in one of these stages is replaced.

3-48 AC-DC POLARITY SWITCH

3-49. The ac-dc polarity switch is provided for selecting either the ac or dc mode of operation. When the ac-dc polarity switch is set to AC, the ac to dc converter is switched into the circuit by sections S4A, S4B, S4C, and S4D. Also, sections S4H and S4G are used to switch 1.1 volts dc to the Kelvin-Varley divider. Section S4E is used to provide proper attenuation in the tvm attenuator.

3-50. For the dc mode of operation, the ac-dc polarity switch may be set to the positive or the negative dc position. As seen in figure 3-2, the polarity switch reverses the transistorized voltmeter - reference voltage combination with respect to the input. Note that a 0.01 uf capacitor (C1) is connected from the COMMON post to the chassis ground post to reduce the effect of ac circulating currents. If the instrument did not contain a polarity switch, the grounded side of any unknown voltage that is negative with respect to ground would have to be connected to the INPUT post. This would ground the INPUT post and effectively place C1 across the input. With this capacitance connected across the circuit being measured several problems would arise. The polarity switch provides equal convenience in measuring positive and negative voltages without the occurance of these problems.

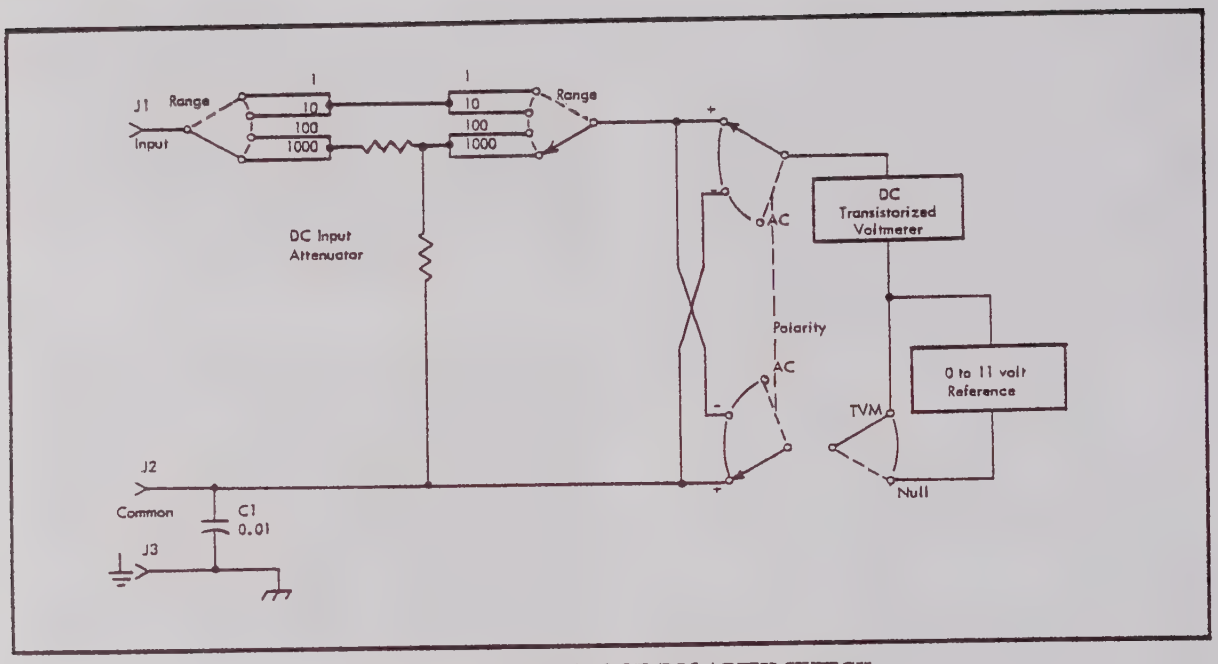


Figure 3-2. FUNCTION OF POLARITY SWITCH

SECTION IV

MAINTENANCE

4-1. INTRODUCTION

4-2. The 883A AC/DC Differential Voltmeter seldom requires any maintenance. Without extreme abuse, all that should be required is periodic cleaning and calibration as specified in this section. However, to determine if the instrument is within specifications, it is recommended that its performance be checked just before calibration by using the performance checks given in this section. If a problem arises, the information on corrective maintenance in this section will be extremely useful.

4-3. TEST EQUIPMENT

4-4. Figure 4-1 lists the recommended equipment and specifications required for performance checking, calibration, and corrective maintenance. If the recommended equipment is not available, other equipment which meets the required specifications may be used.

4-5. PERIODIC MAINTENANCE

4-6. Periodic maintenance consists primarily of occasional cleaning to remove dust, grease, and other types of contamination. However, since the 883A is a completely enclosed unit, the need for occasional cleaning is greatly reduced. Special care has been taken to prevent leakage across critical switch wafers, areas of some printed circuit boards, and from the printed circuit boards to chassis ground. The power, range, null, polarity, and all voltage readout dial switches are vacuum impregnated with Dow Corning silicone oil. These switches are also isolated from the front panel with Lexan spacers. The printed circuit boards are coated with Epocast 8267. Also, the printed circuit boards are isolated from chassis ground by means of polyethelene grommets.

4-7. To prevent excessive electrical leakage, proceed as follows:

CAUTION

Avoid touching polyethelene grommets. The grease on the hands of some people can cause excessive electrical leakage.

a. Blow instrument out with low-pressure, clean. dry air to remove most accumulations of dust and foreign matter. Pay particular attention to the input binding posts, binding post wiring, switches, and polyethelene grommets which insulate printed circuit boards from chassis.

b. Clean polyethelene grommets, binding posts, and front panel with anhydrous denatured ethyl alcohol or a pressure can of Freon TF Degreaser (Miller-Stephenson Chemical Co., Inc.) and, when necessary, a clean cloth or a cotton swab.

CAUTION

Do not use Metriclene, acetone, lacquer thinner, or any other methyl ethyl ketones, since they will react with the Lexan rotor on the CTS plastic switches. Also, be careful not to saturate the switch contacts which have been lubricated for life.

c. When necessary, clean all exposed dielectric surfaces of switches with denatured alcohol using a small, stiff-bristled brush which has been wrapped with a clean cloth to prevent saturating the switch contacts.

d. After cleaning, recoat exposed switch insulating material with a solution of Dow Corning 200 having a viscosity between 5 and 20 centistokes. This prevents leakage due to moisture on these surfaces.

4-8. PERFORMANCE CHECKING

4-9. GENERAL

4-10. The following performance checks are designed to check the instruments performance against the specifications. As such, they may be used as a routine maintenance procedure and as an incoming inspection procedure. They should be accomplished under typical laboratory conditions in a draft free area with an ambient temperature of 72.5 (±2.5)° F. It is recommended that these performance checks be done just before calibration of the instrument. When used in this way, the performance checks yield a valuable case histroy on the characteristics of each individual instrument. Just prior to calibration, the instrument should be within specifications. If the instrument is out of specifications, the error should not be calibrated out of the instrument. The correct procedure is to find the reason why and then eliminate it. Localizing the problem to a particular area of the instrument may be done by an analysis of the performance check results.

NOMEN-CLATURE	SPECIFICATIONS REQUIRED	RECOMMENDED INSTRUMENT	USED FOR	PARA
VTVM	Range: 0 to 40 vdc, 0 to 300 vac Accuracy: ±3% dc, ±5% ac Input Impedance: 10MΩ 5 pf dc 1MΩ, 100 pf ac	RCA Voltohmyst	CORRECTIVE MAINTENANCE -Voltage Level Checking -Reference Voltage Regulation Check -Null Detector Input Stage Bias Adjustment -Converter Input Stage Bias Adjustment -Converter Output Adjustment	 4-44 4-48 4-56 4-58 4-59
Autotransformer	103 to 127 volts (207 to 253 volts for 230 volts nominal line instruments)	General Radio Model W5MT3 Variac (W5HMT for 230 volts nominal line instruments)	CORRECTIVE MAINTENANCE -Reference Voltage Regulation Check	 4-48
DC Differential Voltmeter	Range: 10 to 20 vdc Accuracy: 0.05% Null Range: At least 10 mv.	Almost any FLUKE Differential Voltmeter	CORRECTIVE MAINTENANCE -Voltage Level Checking -Reference Voltage Regulation Check -Negative 18 Volt Supply Adjustment -Converter Supply Adjustment	 4-44 4-48 4-54 4-57
Standard Cell Bank	Accuracy: ±0.0005%	Guildline Instruments Model 9152/P4	PERFORMANCE CHECKING -DC Differential Measurement Check CALIBRATION -DC Preliminary Calibration CORRECTIVE MAINTENANCE -Common Mode Measurement Check	 4-13 4-22 4-49
Power Supply	Voltage: 1 to 1100 vdc Current: 0 to 2 ma Stability: ±0.005% per hour Resolution: 5 mv	FLUKE Model 412B	PERFORMANCE CHECKING -DC Differential Measurement Check CALIBRATION -DC Preliminary Calibration CORRECTIVE MAINTENANCE -Common Mode Measurement Check -Kelvin-Varley Divider Check -Kelvin-Varley Divider Adjustment	 4-13 4-22 4-48 4-51 4-60
Null Detector	Range: 1 uv to 1 mv end scale	FLUKE Model 845A	PERFORMANCE CHECKING -DC Differential Measurement Check CALIBRATION -DC Preliminary Calibration CORRECTIVE MAINTENANCE -Kelvin-Varley Divider Check -Kelvin-Varley Divider Adjustment	 4-13 4-22 4-51 4-60

Figure 4-1. TEST EQUIPMENT REQUIREMENTS (Sheet 1 of 2)

NOMEN-CLATURE	SPECIFICATIONS REQUIRED	RECOMMENDED INSTRUMENT	USED FOR	PARA
Kelvin-Varley Divider	Number of Decades: Seven Input Resistance: 100K Ratio Accuracy: 1 ppm from 1/10 of full scale to full scale	FLUKE Model 720A	PERFORMANCE CHECKING -Differential Measurement Check CORRECTIVE MAINTENANCE -Kelvin-Varley Divider Check -Kelvin-Varley Divider Adjustment	 4-13 4-51 4-60
Lead Compensator	Resolution: 10 mΩ Divider Resistance Ratios: From 1:1 to 10:1	FLUKE Model 721A	CORRECTIVE MAINTENANCE -Kelvin-Varley Divider Check -Kelvin-Varley Divider Adjustment	 4-51 4-60
Voltage Reference Divider	Input Voltage: 10, 100, 1000 vdc Output Voltage: 1, 10, 100, 1000 vdc Accuracy: ±0.001% + 2 uv Divider Current Adjustment Range: To a minimum of 1 ppm and a maximum of 5 ppm on all ranges	FLUKE Model 750A	PERFORMANCE CHECKING -DC Differential Measurement Check CALIBRATION -DC Preliminary Calibration	 4-13 4-22
Oscilloscope	Sweep Range: 1 msec/cm to 10 msec/cm Sensitivity: 2 v/cm	Hewlett Packard Model 120B	CORRECTIVE MAINTENANCE -Chopper Drive Circuit Adjustment	 4-55
Voltage Standard	Voltage: 1 to 1000 vdc Current: 0 to 6 ma Stability: ±0.0005% per hour Resolution: ±0.0005% Accuracy: ±0.004%	FLUKE Model 332A	PERFORMANCE CHECKING -AC Measurement Check -AC Preliminary Calibration	 4-15 4-29
Transfer Standard	Voltage: 1 to 1000 volts Frequency: 400 Hz, 10 kHz, and 20 kHz Accuracy: 0.01%	FLUKE Model 540B	PERFORMANCE CHECKING -AC Measurement Check -AC Preliminary Calibration	 4-15 4-29
AC Source	Voltage: 1 to 1000 volts Frequency: 400 Hz, 10 kHz, and 20 kHz Stability: 0.01% per hour Distortion: Less than 0.05% for each odd harmonic and 1% for each even harmonic	Optimation Model AC-101	PERFORMANCE CHECKING -AC Measurement Check -AC Preliminary Calibration	 4-15 4-29
Wave Analyzer	Frequency: 1 kHz to 1 MHz	Hewlett Packard Model 310A	PERFORMANCE CHECKING -AC Measurement Check -AC Preliminary Calibration	 4-15 4-29

Figure 4-1. TEST EQUIPMENT REQUIREMENTS (Sheet 2 of 2)

4-11. NULL DETECTOR CHECK

4-12. The null detector is checked in this procedure by using the instruments internal reference supply and Kelvin-Varley divider. This is possible because the reference supply and Kelvin-Varley divider are a few hundred times more accurate than the null detector. If the instrument fails to pass this check, there is a remote chance that the cause is due to a faulty reference supply or Kelvin-Varley divider. In this case, the measurement of an appropriate voltage in the TVM mode will indicate if the null detector is operating properly. Proceed as follows:

a. Set 883A meter to zero with mechanical zero control.
b. Set POWER switch to LINE OPR with 883AB or to ON with 883A and allow a warmup period of 5 minutes.
c. Short INPUT post to COMMON post.
d. Set ac-dc switch to + (positive).
e. Set switches on voltmeter as shown in figure 4-2. Meter should indicate within 1-1/2 small scale divisions (±3% of null range) of value shown in figure 4-2.

VOLTMETER SWITCH SETTINGS			
RANGE	NULL	VOLTAGE READOUT DIALS A B C D E	METER INDICATION
10	1.0	1. 0 0 0 00	-1.0
10	.1	0. 1 0 0 00	-1.0
10	.01	0. 0 1 0 00	-1.0
10	.001	0. 0 0 1 00	-1.0
1	.1	.1 0 0 0 00	-1.0
1	.01	.0 1 0 0 00	-1.0
1	.001	.0 0 1 0 00	-1.0
Before proceeding, set RANGE switch to 1, NULL switch to .0001, all voltage readout to zero, and null meter by adjusting electronic ZERO control.			
1	.0001	0 0 0 1 00	-1.0
100	10	1 0. 0 0 00	-1.0
100	1	0 1. 0 0 00	-1.0
100	.1	0 0. 1 0 00	-1.0
100	.01	0 0. 0 1 00	-1.0
1000	100	1 0 0. 0 00	-1.0
1000	10	0 1 0. 0 00	-1.0
1000	1	0 0 1. 0 00	-1.0
1000	.1	0 0 0. 1 00	-1.0
10	1	0. 1 0 0 00	-0.1
10	1	0. 2 0 0 00	-0.2
10	1	0. 3 0 0 00	-0.3
10	1	0. 4 0 0 00	-0.4
10	1	0. 5 0 0 00	-0.5
10	1	0. 6 0 0 00	-0.6
10	1	0. 7 0 0 00	-0.7
10	1	0. 8 0 0 00	-0.8
10	1	0. 9 0 0 00	-0.9
10	1	1. 0 0 0 00	-1.0
10	1	1. 1 0 0 00	-1.1

Figure 4-2. SETTINGS FOR NULL DETECTOR CHECK

f. Remove short from between INPUT and COMMON posts and set POWER switch to OFF.

4-13. DC DIFFERENTIAL MEASUREMENT CHECK

4-14. The following procedure checks the accuracy of the instrument with full input on each dc range and also with each voltage readout dial set to 1, then to 2, 3, 4, 5, 6, 7, 8, and 9 on the 10 volt range. This method allows the accuracy to be checked with a minimum number of measurements. Proceed as follows:

a. Set meter to zero with mechanical zero control.
b. Set POWER switch to LINE OPR with 883AB or to ON with 883A and allow voltmeter to warmup to equilibrium temperature (about 5 minutes).
c. Set up the necessary equipment to provide dc voltages of 1, 10, 100, and 1000 volts with an accuracy of ±(0.0015% + 2 uv). Proceed as follows:
(1) Connect equipment as shown in figure 4-3.

CAUTION

Make sure HIGH VOLTAGE switch on 412B Power Supply is set to off.

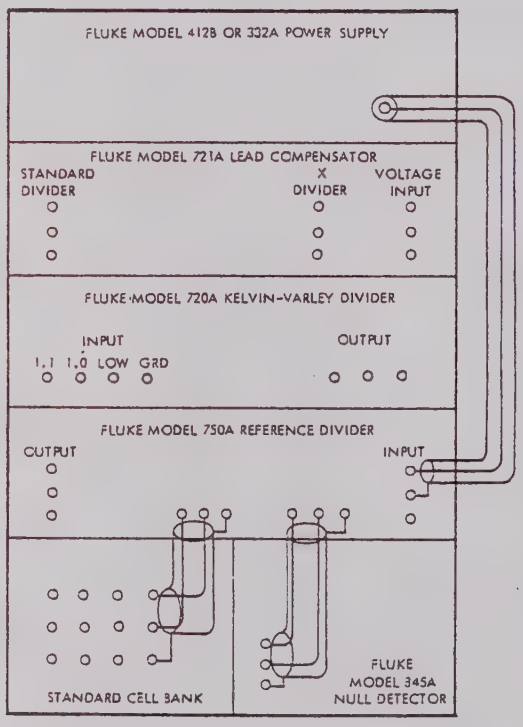


Figure 4-3. DIFFERENTIAL MEASUREMENT CHECK AND CALIBRATION SETUP

(2) Turn on all equipment and allow it to warmup to equilibrium temperature (about 1/2 hour).
(3) Set STANDARD CELL VOLTAGE switches on 750A Reference Divider to voltage of standard cell.

(4) Set INPUT switch on 750A Reference Divider to 1000 volts.

(5) Set voltage dials on 412B Power Supply to 1000 volts.

(6) Set HIGH VOLTAGE switch on 412B Power Supply to ON.

(7) Set 845A Null Detector to 100 MICROVOLTS.

(8) Adjust voltage dials on 412B Power Supply and COARSE and FINE dials on 750A Reference Divider for a null in each successively more sensitive null range on 845A Null Detector. The null detector should be zeroed as necessary.

(9) Voltages of 1, 10, 100, and 1000 volts dc are available at the OUTPUT terminals when the OUTPUT switch is set to the 1, 10, 100, and 1000 volt positions respectively. Note that COARSE and FINE dials on 750A Reference Divider and possibly voltage dials on 412B Power Supply may have to be adjusted to maintain a null on 845A Null Detector due to drifting or loading of the reference divider.

d. Connect 883A ground post to line ground.

e. Short INPUT post to COMMON post.

f. Set 883A ac-dc POLARITY switch to +, RANGE switch to 1, NULL switch to .0001, and all voltage readout dials to 0 (zero).

g. Null meter by adjusting electronic zero control (R239).

h. Remove short from between INPUT and COMMON posts.

i. Set 883A NULL switch to 0.1 and voltage readout dials to 1.000000.

j. Apply 1 volt dc ±(0.0015% + 2 uv) between INPUT and COMMON posts.

k. Adjust voltage readout dials for zero meter deflection in each successively more sensitive null range. Final voltage readout dial setting should be between .999950 and 1.000050.

l. Set 883A RANGE switch to 10, NULL switch to 1, and voltage readout dials to 10.00000.

m. Apply 10 volts dc ±0.0015% between INPUT and COMMON posts.

n. Adjust voltage readout dials for zero meter deflection in each successively more sensitive null range. Final voltage readout dial setting should be between 9.99950 and 10.00050.

o. Set 883A RANGE switch to 100, NULL switch to 10, and voltage readout dials to 100.0000.

p. Apply 100 volts dc ±0.0015% between INPUT and COMMON posts. Note that voltage dials on 412B Power Supply and COARSE and FINE dials on 750A Reference Divider must be readjusted for a null on 845A Null Detector due to loading of voltmeter on 750A Reference Divider.

q. Adjust voltage readout dials for zero meter deflection in each successively more sensitive null range. Final voltage readout dial setting should be between 99.9950 and 100.0050.

r. Set 883A RANGE switch to 1000, NULL switch to 100, and voltage readout dials to 1000.000.

s. Apply 1000 volts dc ±0.0015% between INPUT and COMMON posts. Note that voltage dials on 412B Power Supply and COARSE and FINE dials on 750A Reference Divider must be readjusted for a null on 845A Null Detector because the voltmeter no longer loads 750A Reference Divider.

t. Adjust voltage readout dials for zero meter deflection in each successively more sensitive null range. Final voltage readout dial setting should be between 999.950 and 1000.050.

u. Set up the necessary equipment to provide voltage of 1.111111, 2.222222, ... , 9.999999 volts dc with an accuracy of ±(0.0015% + 2 uv). Proceed as follows:

(1) Set HIGH VOLTAGE switch to off on 412B Power Supply.

(2) Reconnect OUTPUT of 750A Reference Divider to INPUT of 720A Kelvin-Varley Divider as shown in figure 4-4.

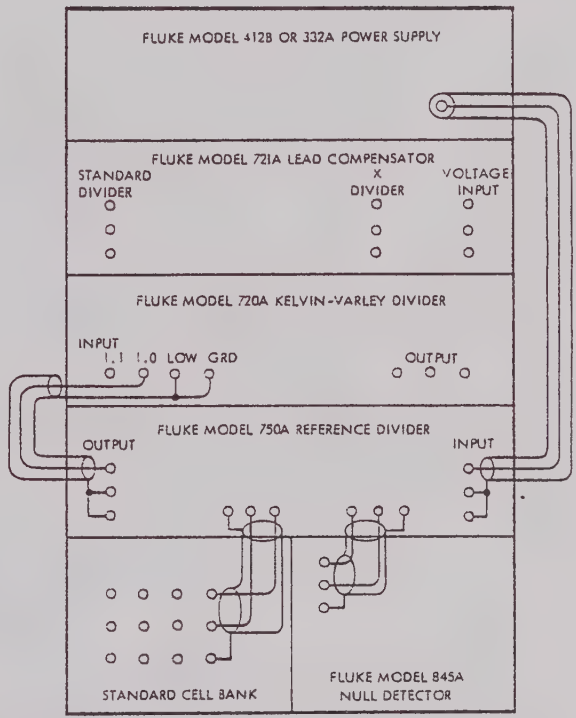


Figure 4-4. REFERENCE SUPPLY AND EXTERNAL KELVIN-VARLEY DIVIDER CHECK SETUP

(3) Set voltage dials to 10 volts on 412B Power Supply.

(4) Set INPUT switch and OUTPUT switch on 750A Reference Divider to 10 volts.

(5) Set HIGH VOLTAGE switch to ON on 412B Power Supply.

(6) Set 845A Null Detector to 100 MICROVOLTS.

(7) Adjust voltage dials on 412B Power Supply and COARSE and FINE dials on 750A Reference Divider for a null in each successively more sensitive null range on 845A Null Detector. The null detector should be zeroed as necessary.

(8) Voltages of 1.111111, 2.222222, ... 9.999999 volts dc are available at the OUTPUT terminals of 720A Kelvin-Varley Divider when all voltage dials are set to 1, 2, ... 9 respectively.

v. Set RANGE switch to 10 and NULL switch to .001 on 883A.

w. Apply voltages listed in figure 4-5 between INPUT

and COMMON posts of 883A, set voltage readout dials on 883A as indicated for applied voltage, and adjust voltage readout dials for a null on 883A meter. Final voltage readout dial settings should be within the values listed in figure 4-5.

VOLTAGES APPLIED TO 883A	INITIAL VOLTAGE READOUT DIAL SETTING	FINAL VOLTAGE READOUT DIAL SETTING
1.111111	1.11111	1.11103 to 1.11119
2.222222	2.22222	2.22209 to 2.22236
3.333333	3.33333	3.33314 to 3.33353
4.444444	4.44444	4.44420 to 4.44469
5.555555	5.55555	5.55525 to 5.55586
6.666666	6.66666	6.66631 to 6.66702
7.777777	7.77777	7.77736 to 7.77819
8.888888	8.88888	8.88842 to 8.88936
9.999999	9.99999	9.99947 to 10.00052

Figure 4-5. VOLTAGE READOUT DIAL LIMITS

4-15. AC MEASUREMENT CHECK

4-16. The following procedure checks the accuracy of the instrument with full input on each ac range at 400 Hz and 20 kHz. Proceed as follows:

a. Zero instrument as stated in paragraph 2-7.
b. Set switches on voltmeter as follows:

RANGE	10
NULL	TVM
ac-dc polarity	AC
voltage readout dials	10.00000

c. Set up the necessary equipment to provide 1000, 100, 10, and 1 volts ac rms such that the average value has an accuracy of 0.03% at 400 Hz and 0.1% at 20 kHz including harmonic distortion.

NOTE

Odd harmonic distortion will cause a maximum error equal to the percent distortion divided by the order of the harmonic. For example, third harmonic distortion of 0.03% will cause an error between -0.01% and +0.01% depending on the phase relationship.

Proceed as follows:

(1) Connect all test equipment as shown in figure 4-6.
(2) Turn on all test equipment and allow it to warmup to equilibrium temperature (about 1/2 hour).
(3) Set dc voltage standard to rms value of ac voltage required.
(4) Apply output of dc voltage standard to transfer standard and null galvanometer by adjusting internal reference supply of transfer standard.
(5) Apply output of ac source to transfer standard and null galvanometer by adjusting ac source voltage. The output of the ac source now equals the required voltage.
(6) Check output of ac source with a wave analyzer to make sure that harmonic distortion is not excessive.

d. Complete procedure indicated for each horizontal line of figure 4-7.

4-17. CALIBRATION

4-18. GENERAL

4-19. The 883A should be calibrated as often as deemed necessary. However, it is recommended that DC Differential Voltmeter Calibration be done every 6 months. The AC to DC Converter Calibration should be done

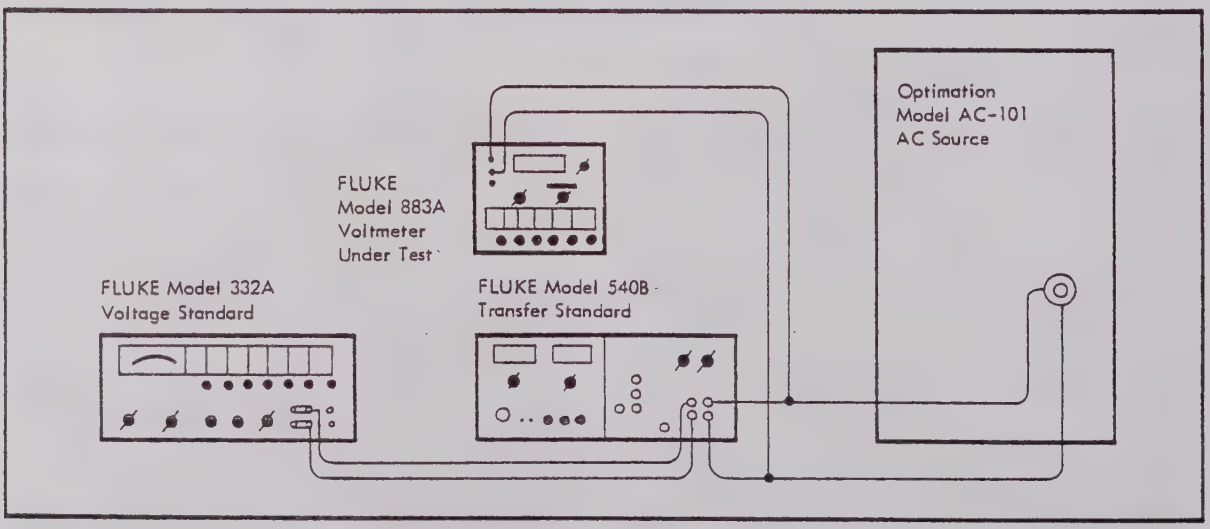


Figure 4-6. AC TO DC CONVERTER CALIBRATION SETUP

Set RANGE switch to	Set NULL switch to	Apply the following voltage between INPUT and COMMON posts	Adjust voltage readout dials for zero meter deflection in each successively more sensitive null range. Final voltage readout dial setting should be between
1	TVM	1 vac, 400 Hz, ±0.03%	.999400 to 1.000600
1	TVM	1 vac, 20 kHz, ±0.10%	.998000 to 1.002000
10	TVM	10 vac, 400 Hz, ±0.03%	9.99400 to 10.00600
10	TVM	10 vac, 20 kHz, ±0.10%	9.98000 to 10.02000
100	TVM	100 vac, 400 Hz, ±0.03%	99.9400 to 100.0600
100	TVM	100 vac, 20 kHz, ±0.10%	99.8000 to 100.2000
1000	TVM	1000 vac, 400 Hz, ±0.03%	999.200 to 1000.800
1000	TVM	1000 vac, 20 kHz, ±0.10%	998.000 to 1002.000

Figure 4-7. AC MEASUREMENT CHECK

every 2 months. For special applications where extreme accuracy is required, it may be desired to calibrate the instrument more frequently. Calibration should be accomplished under typical laboratory conditions in a draft free area with an ambient temperature of 72.5 (±2.5)° F for maximum accuracy. The recommended equipment and the specification required for calibration are shown in figure 4-1. All controls may be located with the aid of figure 4-8.

4-20. DC DIFFERENTIAL VOLTMETER CALIBRATION

4-21. For convenience, DC Differential Voltmeter Calibration is divided into five parts: Preliminary Calibration, Null Detector Calibration, 10 Volt Range Calibration, 1 Volt Range Calibration, and 100 & 1000 Volt Range Calibration. Calibration is normally done by performing all five parts in the sequency given here. However, the calibration procedure is written so that

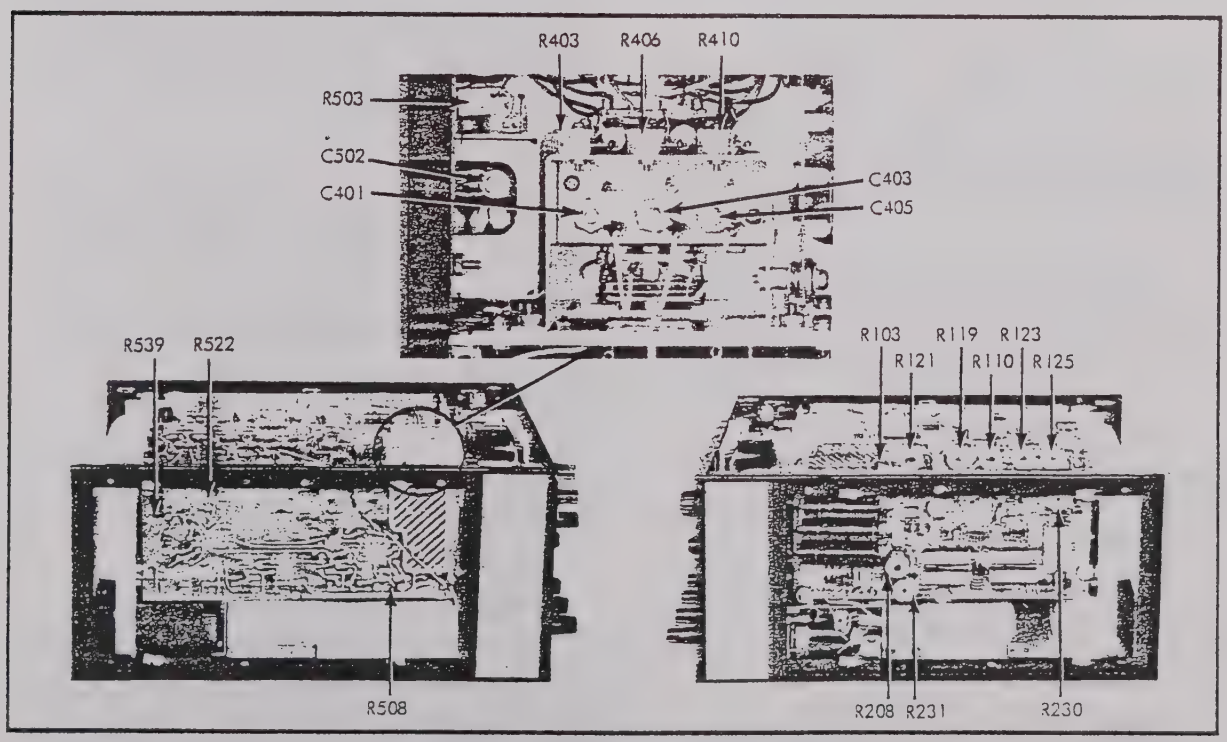


Figure 4-8. ADJUSTMENT LOCATIONS

any section may be calibrated by performing the calibration procedure for that section after performing DC Preliminary Calibration.

4-22. DC PRELIMINARY CALIBRATION

a. Set meter to zero with mechanical zero control.

b. Set switches on 883A as follows:

RANGE	10
NULL	0.001
ac-dc polarity	+
all voltage readout dials	0 (zero)

c. Set POWER switch to LINE OPR with 883AB or to ON with 883A and allow voltmeter to warmup to equilibrium temperature (about 5 minutes).

d. Set up the necessary equipment to provide dc voltages of 100, 10, and 1 volts with an accuracy of ±(0.0015 % + 2 uv). Proceed as follows:

(1) Connect equipment as shown in figure 4-3.

CAUTION

Make sure HIGH VOLTAGE switch on 412B Power Supply is set to off.

(2) Turn on all equipment and allow it to warmup to equilibrium temperature (about 1/2 hour).

(3) Set STANDARD CELL VOLTAGE switches on 750A Reference Divider to voltage of standard cell.

(4) Set INPUT VOLTAGE switch on 750A Reference Divider to 100 volts.

(5) Set voltage dials on 412B Power Supply to 100 volts.

(6) Set HIGH VOLTAGE switch on 412B Power Supply to ON.

(7) Set 845A Null Detector to 100 MICROVOLTS.

(8) Adjust voltage dials on 412B Power Supply and COARSE and FINE dials on 750A Reference Divider for a null in each successively more sensitive null range on 845A Null Detector. The null detector should be zeroed as necessary.

(9) Voltages of 100, 10, and 1 volts dc are available at the OUTPUT VOLTAGE terminals when the OUTPUT VOLTAGE switch is set to the 100, 10 and 1 volt positions respectively.

e. Connect 883A ground post to line ground.

4-23. NULL DETECTOR CALIBRATION

a. Short INPUT post to COMMON post and null meter by adjusting electronic ZERO control (R239).

b. Set switches on 883A as follows:

RANGE	1
NULL	0.1
voltage readout dial A	1

c. Adjust 1 mv gain control R230 for full scale deflection to the left (-1).

d. Set switches on 883A as follows:

RANGE	1
NULL	0.0001
all voltage readout dials	0 (zero)

e. Null meter by adjusting electronic ZERO control (R239). Right side panel must be on instrument when making this adjustment.

f. Set voltage readout dial D to 1 and adjust 100 uv gain control R231 so that meter indicates full scale (-1) when right side panel is replaced.

g. Remove short from between INPUT and COMMON posts.

4-24. 10 VOLT RANGE CALIBRATION

a. Set switches on 883A as follows:

RANGE	10
NULL	1.0
voltage readout dials	10.00000

b. Apply 10 volts dc (±0.0015%) between INPUT and COMMON posts.

c. Adjust 10 volt range control R119 for a zero meter deflection in each successively more sensitive null range.

4-25. 1 VOLT RANGE CALIBRATION

a. Short INPUT post to COMMON post.

b. Set switches on 883A as follows:

RANGE	1
NULL	0.0001
all voltage readout dials	0 (zero)

c. Null meter by adjusting electronic ZERO control (R239). Right side panel must be on instrument when making this adjustment.

d. Remove short from between INPUT and COMMON posts.

e. Set switches on 883A as follows:

RANGE	1
NULL	0.1
voltage readout dials	1.000000

f. Apply 1 volt dc ±(0.0015% + 2 uv) between INPUT and COMMON posts.

g. Adjust 1 volt range control R121 for zero meter deflection in each successively more sensitive null range. Right side panel must be on instrument when making this adjustment.

4-26. 100 AND 1000 VOLT RANGE CALIBRATION

a. Set switches on 883A as follows:

RANGE	100
NULL	10
voltage readout dials	100.0000

b. Apply 100 volts dc (±0.0015%) between INPUT and COMMON posts.

c. Adjust input attenuator control R103 for zero meter deflection in each successively more sensitive null range. Note that this adjustment calibrates both the 100 and 1000 volt range.

4-27. AC TO DC CONVERTER CALIBRATION

4-28. The dc differential voltmeter section of the voltmeter must be within specifications before the ac to dc converter can be accurately calibrated. The ac to dc converter must be calibrated in the following order.

4-29. AC PRELIMINARY CALIBRATION

a. Zero instrument as stated in paragraph 2-7.

b. Set switches on voltmeter as follows:

RANGE	1
NULL	TVM
ac-dc polarity	AC
voltage readout dials	1.000000

c. Set up the necessary equipment to provide: 100, 10, and 1 volts ac rms such that the average value has an accuracy of 0.03% at 400 Hz and 0.1% at 20 kHz including harmonic distortion; 500 or 1000 volts ac rms such that the average value has an accuracy of 0.03% at 400 Hz and 0.05% at 10 kHz including harmonic distortion.

NOTE

Odd harmonic distortion will cause a maximum error equal to the percent distortion divided by the order of the harmonic. For example, third harmonic distortion of 0.03% will cause an error between -0.01% and +0.01% depending on the phase relationship.

Proceed as follows:

(1) Connect all test equipment as shown in figure 4-6.

(2) Turn on all test equipment and allow it to warmup to equilibrium temperature (about 1/2 hour).

(3) Set dc voltage standard to rms value of ac voltage required.

(4) Apply output of dc voltage standard to transfer standard and null galvanometer by adjusting internal reference supply of transfer standard.

(5) Apply output of ac source to transfer standard and null galvanometer by adjusting ac source voltage. The output of the ac source now equals the required voltage.

(6) Check output of ac source with a wave analyzer to make sure that harmonic distortion is not excessive.

4-30. 1 VAC CONVERTER GAIN ADJUSTMENT

a. Apply 1 volt ac (±0.03%) at 400 Hz between INPUT and COMMON posts.

b. Set NULL switch to .001.

c. Adjust 1 vac gain adjust control R503 until meter needle is within 100 microvolts (1 major division) of null.

4-31. 1 VAC HIGH FREQUENCY ADJUSTMENT

a. Apply 1 volt ac (±0.1%) at 20 kHz between INPUT and COMMON posts.

NOTE

The capacitors used for converter frequency adjustments in current instruments have improved humidity protection over the older type. For these instruments a small cap must be unscrewed and removed before making any adjustments and then it must be replaced. These improved capacitors for C401, C403, and C405 are used in serial numbers 570 and on, and for C502 in serial numbers 590 and on.

b. Adjust 1 vac high frequency trim control C502 until meter needle is within 100 microvolts (1 major division) of null.

4-32. 10 VAC ATTENUATOR ADJUSTMENT

a. Set RANGE switch to 10 and NULL switch to TVM.

b. Apply 10 volts ac (±0.03%) at 400 Hz between INPUT and COMMON posts.

c. Set NULL switch to .01.

d. Adjust 10 vac attenuator control R403 until meter needle is within 0 to +1 millivolt (0 to +1 major division) of null. Note that 10, 100, and 1000 volt attenuator controls and 10, 100, and 1000 volt high frequency controls are located from left to right respectively on bracket next to converter board.

4-33. 10 VAC HIGH FREQUENCY ADJUSTMENT

a. Apply 10 volts ac (±0.1%) at 20 kHz between INPUT and COMMON posts.

b. Adjust 10 vac high frequency trim control C401 until meter needle is within 1 millivolt (1 major division) of null.

4-34. 100 VAC ATTENUATOR ADJUSTMENT

a. Set RANGE switch to 100 and NULL switch to TVM.

b. Apply 100 volts ac (±0.03%) at 400 Hz between INPUT and COMMON posts.

c. Set NULL switch to .1.

d. Adjust 100 vac attenuator control R406 until meter needle is within 0 to +10 millivolts (0 to +1 major division) of null.

4-35. 100 VAC HIGH FREQUENCY ADJUSTMENT

a. Apply 100 vac (±0.1%) at 20 kHz between INPUT and COMMON posts.

b. Adjust 100 vac high frequency trim control C403 until meter needle is within 10 millivolts (1 major division) of null.

4-36. 1000 VAC ATTENUATOR ADJUSTMENT

a. Set RANGE switch to 1000, NULL switch to 1, and voltage readout dials to 500.000.

b. Apply 500 volts ac (±0.03%) at 400 Hz between INPUT and COMMON posts.

c. Adjust 1000 vac attenuator control R410 until meter needle is within 50 millivolts (1/2 major division) of null.

NOTE

The preferable calibration voltage for this adjustment is 500 volts ac. If 500 volts ac is not available, 1000 volts ac may be used

by adjusting R410 until meter needle is within 100 millivolts (1 major division) of null.

4-37. 1000 VAC HIGH FREQUENCY ADJUSTMENT

a. Apply 500 volts ac (±0.05%) at 10 kHz between INPUT and COMMON posts.

b. Adjust 1000 vac high frequency trim control C405 until meter needle is within 50 millivolts (1/2 major division) of null.

NOTE

The preferable calibration voltage for this adjustment is 500 volts ac. If 500 volts ac is not available, 1000 volts ac may be used by adjusting C405 until meter needle is within 100 millivolts (1 major division) of null.

4-38. CORRECTIVE MAINTENANCE

4-39. GENERAL

4-40. Since the 883A AC/DC Differential Voltmeter is a completely transistorized instrument of conservative design, the possibility of a component failure is greatly reduced. Under normal circumstances, the only thing that will interfere with the operation of the instrument is the need for calibration. However, if the instrument does not perform correctly after calibration, the technician may use the information given here as a complete guide for locating and correcting the source of trouble. All equipment required for maintaining the instrument is listed in figure 4-1.

4-41. TROUBLESHOOTING

4-42. TROUBLESHOOTING TIPS. The purpose of troubleshooting is to quickly and accurately correct the cause of any abnormal condition. Thus, servicing should begin with an attempt to localize the general area of trouble. By performing a complete performance check as outlined in paragraph 4-8, the trouble may be isolated to the null detector, reference supply, Kelvin-Varley divider, dc input attenuator, or ac to dc converter. To assist in localizing some of the more common troubles that might occur, the causes and remedies for a number of symptoms are listed in the troubleshooting chart (figure 4-9). However, an understanding of the theory of operation and frequent reference to the schematic diagram is the best way to locate the cause of any abnormal condition.

4-43. VISUAL INSPECTION. Trouble can sometimes be found by a thorough visual inspection. Look for:

a. Accumulations of dirt, dust, moisture, or grease. Remove contamination as outlined in periodic maintenance (paragraph 4-5).

b. Scorched or burned parts. Damage of this type is often due to some other defective component. Determine cause of damage before replacing overheated part.

CAUTION

Avoid touching polyethelene gromments. The grease on the hands of some people can cause excessive electrical leakage.

c. Cracks, cuts, and other damage to polyethelene grommets. Replace grommets using a plastic bag over the hand to prevent contamination.

d. Input divider resistors (R100, R101, and R102) touching printed circuit board. When these resistors touch the board, leakage paths are created which can result in meter offset.

e. Loose or intermittent connections.

f. Any other condition which suggests a source of trouble.

4-44. VOLTAGE LEVEL CHECKING. When the trouble has been localized to a stage, the defective part may be isolated by voltage level measurements at the transistor terminals. Figure 4-10 may be used to locate the transistor terminals. When making measurements on printed circuit boards, use a sharp probe and press firmly while rotating probe to break through the insulating

SYMPTOM	PROBABLE CAUSE	REMEDY
Drift of reference supply evidenced by null detector meter needle drift when measuring an extremely stable voltage.	A wire wound resistor (R108, R109, R115, R116, R118, R120, or R122) changing value with temperature.	Locate faulty resistor by heating slightly with a soldering iron held near resistor, while looking for a meter needle change of a standard cell measurement.
	Battery Voltage Low.	Charge Batteries
	Faulty Zener diode.	Monitor voltage across Zener diode pair. Look for drift of Zener voltage. Replace if defective.
	Q101, Q102, Q103, Q104, or Q105 defective.	Check by replacement.

Figure 4-9. TROUBLESHOOTING CHART (Sheet 1 of 2)

SYMPTOM	PROBABLE CAUSE	REMEDY
Meter rattle or drift.	Field effect transistor Q201 defective.	Check as outlined in paragraph 4-46. If rattle is excessive, check Q201 by replacement.
	Chopper G201 defective.	Check as outlined in paragraph 4-46. If rattle is excessive, check G201 by replacement.
	Moisture, dirt, or other contamination on printed circuit boards or switches.	Clean instrument as outlined in paragraph 4-5.
Measurements are out of tolerance on every range when Kelvin-Varley divider is dialed to any setting other than 10999100.	Out of adjustment or one of the Kelvin-Varley divider resistors is out of tolerance.	Check accuracy of Kelvin-Varley divider using paragraph 4-51. If these checks indicate an out of tolerance condition, first try adjusting Kelvin-Varley divider using procedure of paragraph 4-60. If Kelvin-Varley divider cannot be adjusted, use out of tolerance data obtained from procedure of paragraph 4-51 to isolated defective resistor.
Meter cannot be brought to zero with ZERO control.	Chopper drive not symmetrical.	Readjust chopper drive circuit using procedure of paragraph 4-55.
	CR201 or CR202 defective.	Check and replace if defective.
Meter beating with voltage under measurement.	Chopper drive circuit out of adjustment.	Adjust chopper drive circuit using procedure of paragraph 4-55.
NOTE: Assuming all dc measurements are normal, the following symptoms are common to ac measurements only.		
Measurements are out of tolerance on the 1000, 100, or 10 volt ac range only.	Out of calibration.	Recalibrate per paragraph 4-27.
	One or more resistors in the 1000, 100, or 10 volt ac attenuator has shifted in value.	Recalibrate per paragraph 4-27.
Measurements are out of tolerance on all ac ranges.	Out of calibration.	Recalibrate per paragraph 4-27.
	Transistor Q501, Q502, Q503, Q504, Q505, or Q506 faulty.	Check by measuring dc bias voltages or by replacement.
	R501, R504, R530, or R531 has shifted in value.	Recalibrate per paragraph 4-27.
Measurements are out of tolerance at some frequencies.	Out of calibration.	Recalibrate per paragraph 4-27.
	Faulty frequency compensation capacitor.	Locate faulty capacitor and replace. If trouble occurs on all ranges, check C501 and C503. If trouble occurs on 1000 volt range only, check C406 and C407. If trouble occurs on 100 volt range only check C404. If trouble occurs on 10 volt range only, check C402.

Figure 4-9. TROUBLESHOOTING CHART (Sheet 2 of 2)

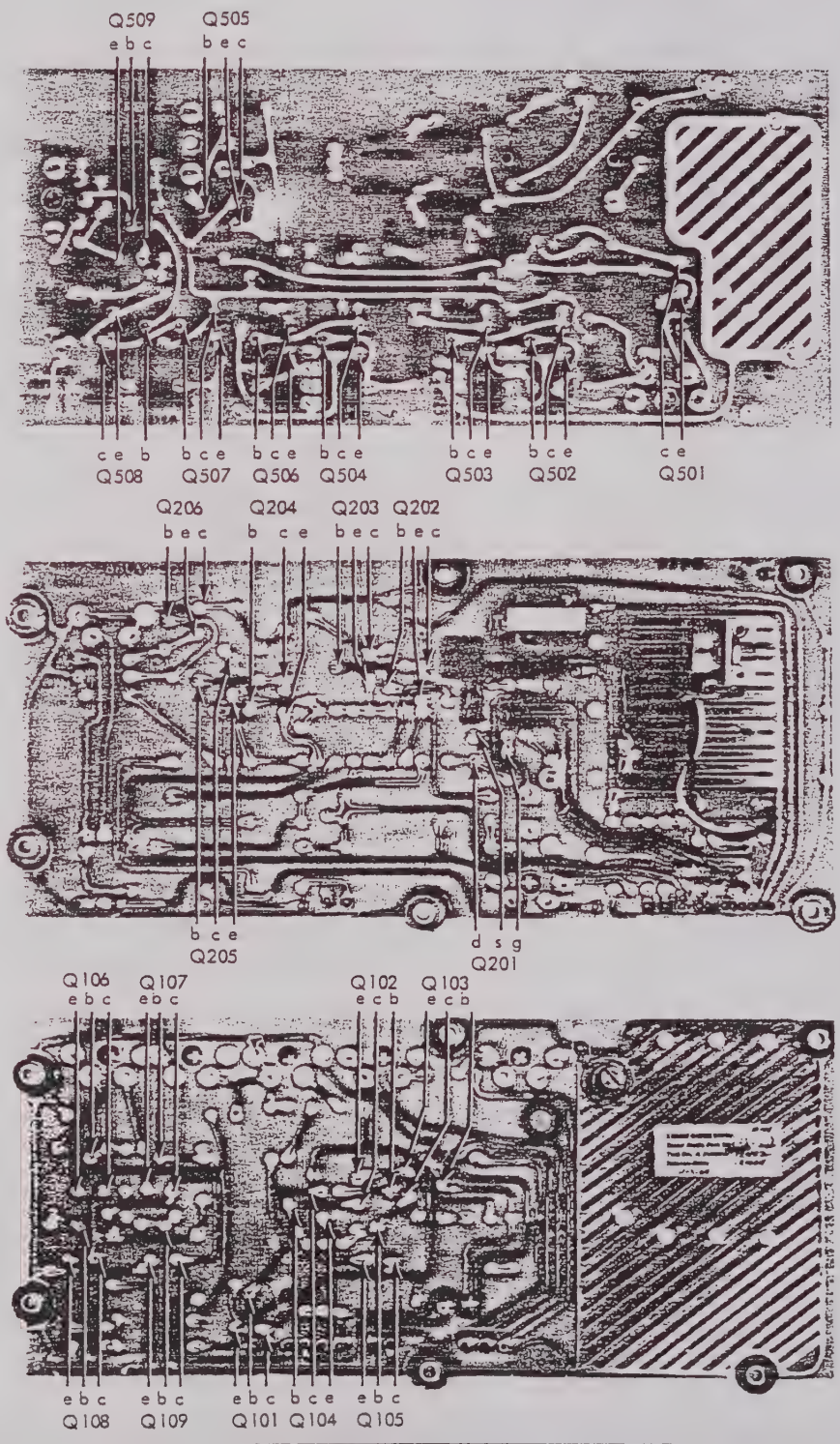


Figure 4-10. TRANSISTOR TERMINAL LOCATIONS

coating. Measurements that differ widely from those listed in the transistor voltage chart (figure 4-11) can be used along with the schematic to localize the trouble to a specific part, in most cases.

CAUTION

When measuring voltage, it is recommended that care be used to avoid momentary short circuits which could damage components.

4-45. TROUBLESHOOTING CHECKS. The following troubleshooting checks list several normal conditions that should exist in the instrument. The most probable cause or causes of an abnormal condition in these checks is also given.

4-46. Meter Rattle Check. If the meter needle appears to rattle excessively, perform the following check:

a. Set switches on 883A as follows:

TRANSISTOR	EMITTER	BASE	COLLECTOR
Q101	-30 (1)	-29.4	-18.0 (2)
Q102	-13	-12.4	- 7.1
Q103	-13	-12.4	- 6.7
Q104	- 6.5	- 7.1	-29.4
Q105	- 6.5	- 6.7	-18.0 (2)
Q106	6.9 (5)	5.9	3.0
Q107	6.9 (5)	5.9	3.0
Q108	0	.16	3.0
Q109	0	.16	3.0
Q201	- 3.3 (SOURCE)	0 (GATE)	-10 (DRAIN)
Q202	-16.6	-16	-12.4
Q203	-13	-12.4	-10
Q204	-18.0 (2)	-17.4	-15.4
Q205	-16	-15.4	- 9.5
Q206	0	+ 2.5	0
Q501	7.1 (SOURCE)	5.5 (GATE)	11 (DRAIN)
Q502	0	0.6	3.5
Q503	2.7	3.5	8.2
Q504	0	0.7	3.7
Q505	11.3	11.9	18.0 (4)
Q506	3.0	3.7	9.5
Q507	34.0 (3)	33	18.0 (4)
Q508	1.7	2.2	33
Q509	6.8	6.2	2.2

The above operating voltage levels are measured under the following conditions: (a) Line voltage at 115/230 vac, 50 to 440 Hz. (b) All voltages measured with a 3%, 10 megohm, 5 pf voltmeter unless otherwise indicated. (c) All voltages for Q501 to Q509 are measured from specified terminal to ac to dc converter common. The COMMON post is ac to dc converter common when ac-dc polarity switch is set to AC. (d) All other voltages are measured from specified terminal to reference supply - null detector common. The COMMON post is reference supply - null detector common when in TVM mode or when in a NULL mode with all voltage dials set to 0 and polarity switch set to +. (e) Some voltages may vary as much as 15 to 20%; (f) Bias voltages (difference between emitter and base voltages) should remain approximately the same; (g) All voltages are dc unless otherwise indicated.

NOTES: (1) Emitter of Q101 as measured with a differential voltmeter should be between -26 and -34 vdc for ON (883A) and LINE OPR (883AB) at 115/230 vac line, -19.5 and -21.0 vdc for BAT OPR (883AB only), and not less than -23.5 vdc for BAT CHG (883AB only) at 115/230 vac line. (2) Collector of Q101 and Q105 and emitter of Q204 as measured with a differential voltmeter should be between -17.9 and -18.1 vdc. (3) Emitter of Q507 as measured with a differential voltmeter should be between +26 and +35 vdc for ON (883A) and LINE OPR (883AB) at 115/230 vac line, +19.5 and +21.0 vdc for BAT OPR (883AB only), and not less than +23.5 vdc for BAT CHG (883AB only) at 115/230 vac line. (4) Collector of Q507 and Q505 as measured with a differential voltmeter should be between +17.9 and +18.1 vdc with less than 200 uv rippie. (5) Emitter of Q106 and Q107 as measured with a differential voltmeter should be between -6.3 and -7.0 vdc for ON (883A) and LINE OPR (883AB) at 115/230 vac line and -4.9 and -5.3 vdc for BAT OPR (883AB only).

Figure 4-11. TRANSISTOR VOLTAGE CHART

RANGE	1
NULL	.0001
ac-dc polarity	+
all voltage readout dials	0 (zero)

b. Set POWER switch to LINE OPR with 883AB or to ON with 883A and allow a 5 minute warmup period.
c. Short INPUT post to COMMON post. Random excursions of meter needle should be less than 1 small division peak-to-peak. If rattle is excessive, check field-effect transistor Q201 by replacement. If meter rattle is still excessive, chopper is probably faulty.

4-47. Leakage Resistance Check. Leakage from the -18 volt supply to chassis ground causes an error in differential measurements. This error is much greater in the negative polarity because the leakage current flows through the tvm attenuator in the negative polarity. This provides a convenient way to check for excessive leakage. Proceed as follows:

a. Zero instrument as stated in paragraph 2-7.
b. Short COMMON post to chassis ground post.
c. Set switches on instrument as follows:

RANGE	1
NULL	.0001
ac-dc polarity	- (negative)
all voltage readout dials	0 (zero)

d. Meter needle should indicate less than 1/2 major division (5 uv). If leakage is excessive, clean instrument as instructed in paragraph 4-5 and check polyethelene grommets as instructed in paragraph 4-43.

4-48. Reference Voltage Regulation Check. If the reference voltage is suspected of being faulty, perform the following check:

a. Connect adjustable autotransformer to line power.
b. Connect 883A line cord to output of autotransformer.
c. Set POWER switch to LINE OPR with 883AB or to ON with 883A and allow a 5 minute warmup period.
d. Set autotransformer to 103 volts (207 volts when 883A is wired for 230 volts nominal) as measured with a VTVM.
e. Set NULL switch to TVM and ac-dc polarity switch to +.
f. Differentially measure -18 volt supply between COMMON post and collector of Q101 with a differential voltmeter.
g. Set autotransformer to 127 volts (253 volts when 883A is wired for 230 volts nominal) as measured with a VTVM. Output of -18 volt supply should change by less than 3.5 millivolts from step f. If regulation is excessive, check transistors Q101 through Q105.

4-49. Common Model Measurement Check. If the instrument is suspected of making incorrect common mode measurements, perform the following check:

a. Measure the voltage of a standard cell in the 1 volt range and in the positive polarity.
b. Connect 500 volts dc from chassis ground post to COMMON post and wait about 3 minutes.
c. Measure voltage of standard cell. If the measurements are not within 50 microvolts of each other, there is excessive electrical leakage to ground. Clean instrument as instructed in paragraph 4-5.

4-50. Converter Offset Check. If low level voltage measurements are not accurate, perform the following check:

a. Set switches on 883A as follows:

RANGE	1
NULL	.001
ac-dc polarity	AC
all voltage readout dials	0 (zero)

b. Set POWER switch to LINE OPR with 883AB or to ON with 883A and allow a 5 minute warmup period.
c. Short INPUT post to COMMON post. Meter needle should indicate less than 160 uv after all transients have stopped. If noise is excessive, check Q501, CR502, and for converter power supply ripple less than 200 uv.

4-51. Kelvin-Varley Divider Check. The Kelvin-Varley check requires that connections to the Kelvin-Varley divider be made inside the instrument. Also, the Kelvin-Varley check takes a considerable amount of time to perform. Therefore, this check should be performed only if the differential measurement check (paragraph 4-13) indicates there is a problem or if the Kelvin-Varley divider has been adjusted (paragraph 4-60). Proceed as follows:

a. Disconnect 883A from line power.
b. Set POWER switch to OFF and set NULL switch to TVM.
c. Remove bottom panel and top-back panel.
d. Locate high input (wire from Kelvin-Varley board to range switch S2, usually purple or point 13 on Kelvin-Varley board), high output (wire from R12 to null switch S3, usually yellow), and input-output common (wire from Kelvin-Varley board to voltage dial A, S5, usually black or point 1 on Kelvin-Varley board) of Kelvin-Varley divider.

CAUTION

Make sure HIGH VOLTAGE switch on 412B Power Supply is set to off.

e. Connect equipment as shown in figure 4-12.
f. Turn all equipment on and allow it to warmup to equilibrium temperature (about 1/2 hour).
g. Set voltage dials on 412B Power Supply for an output of 11.0 volts dc.
h. Set 883A voltage readout dials to 000000 and 720A Kelvin-Varley Divider dials to 0000000.
i. Set 845A Null Detector to 30 MICROVOLTS.
j. Set function switch to VOLTAGE OFF on 721A Lead Compensator.
k. Zero 845A Null Detector
l. Set function switch to $R_S > R_X$ on 721A Lead Compensator.
m. Adjust LOW BALANCE controls on 721A for a null on 845A. It may be necessary to temporarily reduce sensitivity of 845A to find null point on LOW BALANCE controls.

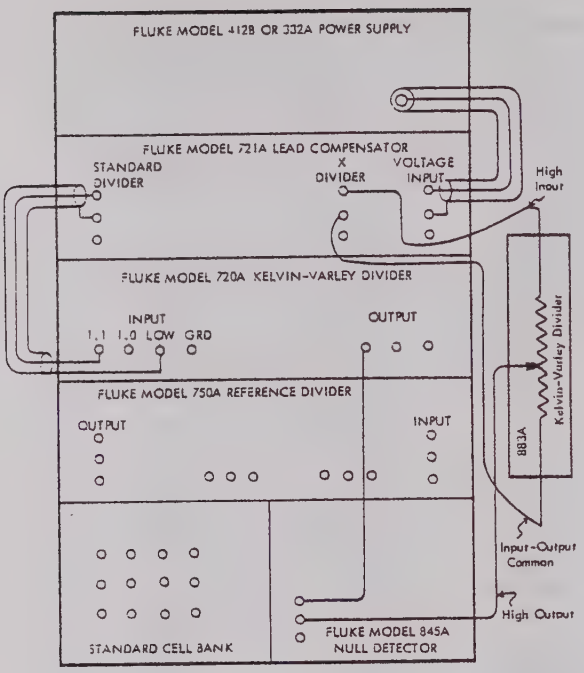


Figure 4-12. KELVIN-VARLEY DIVIDER CHECK SETUP

n. Set 883A voltage dials to 10999100 and 720A Kelvin-Varley dials to 109999910.

o. Set function switch to VOLTAGE OFF on 721A Lead Compensator.

p. Zero 845A Null Detector.

q. Set function switch to $R_S > R_X$ on 721A Lead Compensator.

r. Adjust HIGH BALANCE controls on 721A for a null on 845A. It may be necessary to temporarily reduce sensitivity of 845A to find null point on HIGH BALANCE controls.

s. Set 845A Null Detector to 300 MICROVOLTS and change to 100 MICROVOLTS and 30 MICROVOLTS as required.

t. Set 883A voltage readout dials and 720A Kelvin-Varley Divider dials to first positions shown in figure 4-13.

u. Set function switch to VOLTAGE OFF on 721A Lead Compensator.

v. Zero 845A Null Detector.

w. Set function switch to $R_S > R_X$ on 721A Lead Compensator. The 845A Null Detector indication should be equal to or less than the listed deviation.

x. Repeat steps u through w for remaining switch positions shown in figure 4-13. If Kelvin-Varley divider is out of tolerance between settings of 1000000 and 0999100, readjust as set forth in paragraph 4-60. If a resistor-trimmer combination of the first deck can not be adjusted for a null during adjustment, the 4999.2 ohm resistor is defective and must be replaced. If Kelvin-Varley divider is out of tolerance for remaining settings, make sure padding trimmers are adjusted correctly (paragraph 4-60) before attempting to replace a resistor.

4-52. ELECTRONIC ADJUSTMENTS

4-53. The following electronic adjustments are not performed during calibration because they may never require adjusting during the life of the instrument under normal circumstances. All controls may be located with the aid of figure 4-8.

4-54. NEGATIVE 18 VOLT SUPPLY ADJUSTMENT. Sampling string resistor R110 should be adjusted whenever a part in the -18 volt power supply is replaced. If R110 is adjusted, it will be necessary to perform the 10 volt and 1 volt range calibration (paragraph 4-24 and 4-25). Proceed as follows:

a. Set POWER switch to LINE OPR with 883AB or to ON with 883A.
b. Set NULL switch to TVM.
c. Connect a differential voltmeter between COMMON post and junction of C104 and R112.
d. Set up differential voltmeter to differentially measure -18.0 volts dc.
e. Adjust R110 for -18.0 (±0.1) volts.
f. Perform 10 volt and 1 volt range calibration.

4-55. CHOPPER DRIVE CIRCUIT ADJUSTMENT. The chopper drive circuit should be adjusted for symmetry and frequency if a part in the chopper drive circuit is replaced, if there is difficulty in zeroing the meter, or if line operation causes the meter to beat due to the relationship of the chopper frequency with the line power frequency. Proceed as follows:

a. Set POWER switch to LINE OPR with 883AB or to ON with 883A.
b. Set NULL switch to TVM and ac-dc polarity switch to +.
c. Connect oscilloscope between COMMON post and one side of the chopper drive coil G201 to observe the output waveform.
d. Adjust R125 until output is within ±10% of symmetry.
e. Adjust R123 for a frequency of 84 (±1) Hz.

4-56. NULL DETECTOR INPUT STAGE BIAS ADJUSTMENT. The bias of field-effect transistor Q201 should be adjusted if it or any component in its drain-sink circuit is replaced. Proceed as follows:

a. Set POWER switch to LINE OPR with 881AB or to ON with 883A.
b. Set NULL switch to TVM and ac-dc polarity switch to -.
c. Adjust R208 until voltage from COMMON post to drain of Q201 (junction of C207 and R207) is -10 (±0.5) volts as measured with a VTVM.

4-57. CONVERTER SUPPLY ADJUSTMENT. Sampling string resistor R539 should be adjusted whenever a part in the converter power supply is replaced. Proceed as follows:

a. Set POWER switch to LINE OPR with 883AB or to ON with 883A.
b. Connect a differential voltmeter across C523.
c. Set up differential voltmeter to differentially measure -18.0 vdc.

883A Voltage Dial Settings	Standard Divider Settings	Maximum Deviation for an Input of 11.0 vdc (± microvolts)
1000000	10000000	200
9999100	10000000	200
900000	9000000	180
8999100	9000000	180
800000	8000000	160
7999100	8000000	160
700000	7000000	140
6999100	7000000	140
600000	6000000	120
5999100	6000000	120
500000	5000000	100
4999100	5000000	100
400000	4000000	80
3999100	4000000	80
300000	3000000	60
2999100	3000000	60
200000	2000000	40
1999100	2000000	40
100000	1000000	20
0999100	1000000	20
090000	0900000	20
0899100	0900000	20
080000	0800000	20
0799100	0800000	20
070000	0700000	20
0699100	0700000	20
060000	0600000	20
0599100	0600000	20
050000	0500000	20
0499100	0500000	20
040000	0400000	20
0399100	0400000	20
030000	0300000	20
0299100	0300000	20
020000	0200000	20
0199100	0200000	20
010000	0100000	20
0099100	0100000	20
009000	0090000	20
0089100	0090000	20
008000	0080000	20
0079100	0080000	20

883A Voltage Dial Settings	Standard Divider Settings	Maximum Deviation for an Input of 11.0 vdc (± microvolts)
007000	0070000	20
0069100	0070000	20
006000	0060000	20
0059100	0060000	20
005000	0050000	20
0049100	0050000	20
004000	0040000	20
0039100	0040000	20
003000	0030000	20
0029100	0030000	20
002000	0020000	20
0019100	0020000	20
001000	0010000	20
0009100	0010000	20
000900	0009000	20
0008100	0009000	20
000800	0008000	20
0007100	0008000	20
000700	0007000	20
0006100	0007000	20
000600	0006000	20
0005100	0006000	20
000500	0005000	20
0004100	0005000	20
000400	0004000	20
0003100	0004000	20
000300	0003000	20
0002100	0003000	20
000200	0002000	20
0001100	0002000	20
000100	0001000	20
0000100	0001000	20
000090	0000900	20
000080	0000800	20
000070	0000700	20
000060	0000600	20
000050	0000500	20
000040	0000400	20
000030	0000300	20
000020	0000200	20
000010	0000100	20
000000	0000000	0

Figure 4-13. KELVIN-VARLEY DIVIDER ERROR LIMITS

d. Adjust R539 for +18.0 (±0.1) vdc.

4-58. CONVERTER INPUT STAGE BIAS ADJUSTMENT. The bias of field-effect transistor Q501 should be adjusted if it or any component in its drain-sink circuit is replaced. Proceed as follows:

a. Set POWER switch to LINE OPR with 883AB or to ON with 883A.

b. Adjust R508 until voltage from converter common to drain of Q501 (lead from Q501 to R507) is +11.0 (±0.5) vdc as measured with a VTVM.

4-59. CONVERTER OUTPUT ADJUSTMENT. The converter output should be adjusted with R522 when Q505, Q506, or any component in these two stages is replaced. Proceed as follows:

a. Set POWER switch to LINE OPR with 883AB or to ON with 883A.

b. Adjust R522 until voltage from converter common to collector of Q506 is 9.5 (+0.5/-1.5) vdc as measured with a VTVM. If voltage will not reach 9.5 vdc, it should be at least 8.0 vdc.

4-60. KELVIN-VARLEY DIVIDER ADJUSTMENT. The Kelvin-Varley divider should be adjusted only after a resistor has been replaced or after the Kelvin-Varley divider check (paragraph 4-51) indicates that the Kelvin-Varley divider is out of tolerance. Proceed as follows:

a. Disconnect 883A from power line.
b. Set POWER switch to OFF and NULL switch to TVM.
c. Remove bottom cover.
d. Open jumpers marked with a U, V, W, X, Y, and Z by unsoldering one end and pulling it loose. Also unsolder high input of Kelvin-Varley divider (wire from Kelvin-Varley board to range switch S2, usually purple).
e. Connect equipment as shown in figure 4-14.
f. Turn on all equipment and allow it to warmup to equilibrium temperature (about 1/2 hour).

CAUTION

Do not allow power supply voltage to exceed 10 volts as damage to the Kelvin-Varley resistors may result.

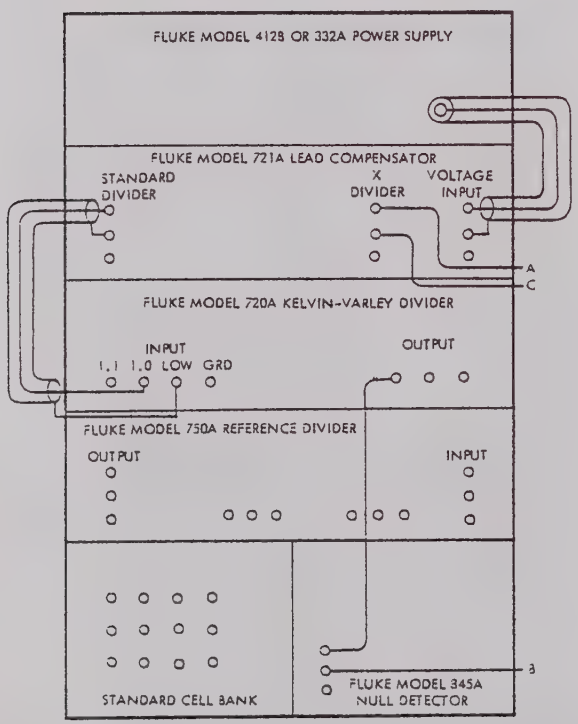


Figure 4-14. KELVIN-VARLEY DIVIDER ADJUSTMENT SETUP

g. Set 412B Power Supply for an output of 4 volts dc.
h. Connect points A and C of figure 4-12 to test points 14 and 16 of Kelvin-Varley board respectively.
i. Eliminate errors due to resistance of leads and connections as follows:
(1) Set 845A Null Detector to 30 MICROVOLTS.
(2) Set 720A Kelvin-Varley Divider dials to 0000000.
(3) Connect point B of figure 4-14 to test point that point C is connected to.
(4) Set function switch to VOLTAGE OFF on 721A Lead Compensator.
(5) Adjust ZERO control to null meter on 845A Null Detector.
(6) Set function switch to $R_S > R_X$ on 721A Lead Compensator.
(7) Adjust LOW BALANCE controls on 721A Lead Compensator for a null on 845A. It may be necessary to temporarily reduce sensitivity of 845A to find null point on LOW BALANCE controls.
(8) Set 721A Kelvin-Varley Divider dials to 10000000.
(9) Connect point B of figure 4-14 to test point that point A is connected to.
(10) Repeat steps (4), (5), and (6).
(11) Adjust HIGH BALANCE controls on 721A for a null on 845A. It may be necessary to temporarily reduce sensitivity of 845A to find null point on HIGH BALANCE controls.
j. Set voltage dial E to 50.
k. Connect point B of figure 4-14 to test point 15.
l. Set 720A Kelvin-Varley Divider to 5000000.
m. Eliminate error due to thermal voltages as follows:
(1) Set function switch to VOLTAGE OFF on 721A Lead Compensator.
(2) Set 845A Null Detector to 30 MICROVOLTS and adjust ZERO control to null meter.
(3) Set function switch to $R_S > R_X$ on 721A Lead Compensator.
n. Set 845A Null Detector to 1 MILLIVOLT.
o. Adjust R303 (at point P) to within ±200 microvolts of null.
p. Reconnect points A and C to test points 17 and 18 respectively.
q. Solder down jumpers Z and Y.
r. Repeat step i.
s. Connect point B to test point 19.
t. Repeat steps m and n.
u. Adjust R316 (at point N) to within ±50 microvolts of null.
v. Reconnect points A and C to test points 20 and 21 respectively.
w. Solder down jumpers X and W.
x. Repeat step i.
y. Connect point B to test point 22.
z. Repeat steps m and n.
aa. Adjust R329 (at point M) to within ±20 microvolts of null.
ab. Set 412B Power Supply for an output of 18 volts dc.
ac. Reconnect points A and C to test points 23 and 24 respectively.
ad. Solder down jumper V.
ae. Repeat step i.
af. Connect point B to test point 25.
ag. Set 720A Kelvin-Varley Divider dials to 6666667.
ah. Make adjustments as given in each horizontal line of figure 4-15.
ai. Solder down jumper U and high input wire of Kelvin-Varley divider.
aj. Check accuracy of Kelvin-Varley divider using procedure of paragraph 4-51.

4-61. MECHANICAL DRUM ADJUSTMENTS

4-62. Occasionally the need may arise to align the po-

Set Voltage Dial A To	Short Test Points	Eliminate Thermal Voltage Errors as in step m	Set 845A Null Detector to 100 microvolts	Adjust Control to Within ±15 microvolts of Null at Point		Remove Short from Between
0	2 to 3	"	"	R364	A	2 and 3
0	1 to 2	"	"	R362	B	1 and 2
2	4 to 5	"	"	R360	C	4 and 5
2	3 to 4	"	"	R358	D	3 and 4
4	6 to 7	"	"	R356	E	6 and 7
4	5 to 6	"	"	R354	F	5 and 6
6	8 to 9	"	"	R352	G	8 and 9
6	7 to 8	"	"	R350	H	7 and 8
8	10 to 11	"	"	R348	I	10 and 11
8	9 to 10	"	"	R346	J	9 and 10
10	12 to 13	"	"	R344	K	12 and 13
10	11 to 12	"	"	R342	L	11 and 12

Figure 4-15. KELVIN-VARLEY "A" DECK ADJUSTMENT

larity switch drum or one of the voltage dial drums in the readout windows. Also, if the drive gear on a switch or dial shaft is no longer in line with the drum shaft, the gears may bind as the dials are turned. Proceed as follows:

a. Remove both side front-covers and the bottom cover from 883A.
b. Stand instrument on rear.
c. Make sure that drive gear on polarity switch shaft and drive gear on shaft of voltage dial E are in line with drum shaft. If not, loosen set screw of drive gear with a 1/16" hex key and align drive gear with drum shaft.
d. Loosen adjusting bracket at left side of instrument and position drum shaft up or down until there is just discernible backlash. That is, until polarity drum just moves when rotated with a finger without moving drive gear on polarity switch shaft.
e. Loosen adjusting bracket at right side of instrument and position drum shaft until there is just discernible backlash for drum of voltage dial E.
f. Turn polarity switch and all voltage dials fully counterclockwise.
g. Loosen set screw of drive gear for drum being aligned and slide drive gear toward back of instrument.

NOTE

See step 1. for adjustment of voltage dial E.

h. Insert finger through window and hold drum being aligned in desired position.
i. Insert hex key into set screw of drive gear and lift drive gear into place allowing it to turn counterclockwise as the teeth mesh.
j. When drive gear is in line with drum shaft tighten set screw.
k. Check character alignment in window. If necessary, loosen set screw and rotate drive gear slightly for final adjustment.
l. To align drum for voltage dial E, loosen set screw of drive gear and slide toward rear of instrument.
m. Insert hex key into set screw of drive gear and lift drive gear into alignment with drive shaft while noting how much drum turns.
n. Slide drive gear toward rear of instrument.
o. Position drum so that 00 position will line up with pointer when gear is raised into position.
p. Raise drive gear into alignment with drum shaft and position 00 in line with pointer by rotating drive gear slightly before tightening set screw.

SECTION V

LIST OF REPLACEABLE PARTS

5-1. INTRODUCTION

5-2. This section of the manual contains a listing of replaceable components for this instrument. The first listing contains a complete breakdown of all the major assemblies followed by subsequent listings that itemize the components on each major assembly. An illustration accompanies each major assembly listing to aid in locating the listed components.

5-3. Assemblies and subassemblies are identified by a reference designation beginning with the letter A followed by a number (e.g., A1 etc.). Electrical components appearing on the schematic diagram are identified by their schematic diagram reference designation. Components not appearing on the schematic diagram are consecutively numbered throughout the parts list. These components are identified with whole numbers on the arrow call-out illustrations and by index numbers on the grid illustrations. Flagnotes are used throughout the parts list and refer to special ordering explanations that are located in close proximity to the flagnotes.

5-4. COLUMN DESCRIPTION

a. The REF DESIG column indexes the item description to the associated illustration. In general the reference designations are listed under each assembly in alpha-numeric order. Subassemblies of minor proportions are sometimes listed with the assembly of which they are a part. In this case, the reference designations for the components of the subassembly may appear out of order.

b. The INDEX NO. column lists coordinates which locate the designated part on the associated grid illustrations.

c. The DESCRIPTION column describes the salient characteristics of the component. Indention of the description indicates the relationship to other assemblies, components, etc. In many cases it is necessary to abbreviate in this column. For abbreviations and symbols used, see the following page.

d. The six-digit part number, by which the item is identified at the John Fluke Mfg. Co., is listed in the STOCK NO. column. Use this number when ordering parts from the factory or authorized representatives.

e. The Federal Supply Code for the item manufacturer is listed in the MFR column. An abbreviated list of Federal Supply Codes is included in the Appendix.

f. The part number which uniquely identifies the item to the original manufacturer is listed in the MFR PART NO. column. If a component must be ordered by description, the type number is listed.

g. The TOT QTY column lists the total quantity of the items used in the instrument and reflects the latest Use Code. Second and subsequent listings of the same item are referenced to the first listing with the abbreviation REF. In the case of optional subassemblies, plug ins, etc. that are not always part of the instrument, or are deviations from the basic instrument model, the TOT QTY column lists the total quantity of the item in that particular assembly.

h. Entries in the REC QTY column indicate the recommended number of spare parts necessary to support one to five instruments for a period of two years. This list presumes an availability of common electronic parts at the maintenance site. For maintenance for one year or more at an isolated site, it is recommended that at least one of every part in the instrument be stocked. In the case of optional subassemblies, plug-ins, etc. that are not always part of the instrument, or are deviations from the basic instrument model, the REC QTY column lists the recommended quantity of the item in that particular assembly.

i. The USE CODE column identifies certain parts which have been added, deleted or modified during

the production of the instrument. Each part for which a Use Code has been assigned may be identified with a particular instrument serial number by consulting the Serial Number Effectivity List at the end of the parts list. Sometimes when a part is changed, the new part can and should be used as a replacement for the original part. In this event a parenthetical note is added in the DESCRIPTION column.

5-5. HOW TO OBTAIN PARTS

5-6. Standard components have been used wherever possible. Standard components may be ordered directly from the manufacturer by using the manufacturer's part number, or parts may be ordered from the John Fluke Mfg. Co. factory or authorized representative by using the Fluke part number. In the event the part you order has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions, if necessary.

5-7. You can insure prompt and efficient handling of your order to the John Fluke Mfg. Co. if you include the following information:

a. Quantity.

b. FLUKE Stock Number.

c. Description.

d. Reference Designation.

e. Instrument model and serial number.

Example: 2 each, 177105, Transistors, 2N3565, Q107-108 for 845AR, s/n 168.

If you must order structural parts not listed in the parts list, describe the part as completely as possible. A sketch of the part, showing its location to other parts of the instrument, is usually most helpful.

5-8. LIST OF ABBREVIATIONS

ac	alternating current	MHz	megahertz	rfi	radio frequency interference
Al	Aluminum	M	megohm		
amp	ampere	met flm	metal film	res	resistor
assy	assembly	ua	microampere	rms	root mean square
cap	capacitor	uf	microfarad	rtry	rotary
car flm	carbon film	uh	microhenry	sec	second
C	centrigrade	usec	microsecond	sect	section
cer	ceramic	uv	microvolt	S/N	serial number
comp	composition	ma	milliampere	Si	silicon
conn	connector	mh	millihenry	scr	silicon controlled rectifier
db	decibel	m	milliohms	spdt	single-pole, double-throw
dc	direct current	msec	millisecond	spst	single-pole, single-throw
dpdt	double-pole, double-throw	mv	millivolt	sw	switch
dpst	double-pole, single-throw	mw	milliwatt	Ta	tantalum
elect	electrolytic	na	nanoampere	tstr	transistor
F	fahrenheit	nsec	nanosecond	tvm	transistor voltmeter
Ge	germanium	nv	nanovolt	uhf	ultra high frequency
gmv	guaranteed minimum value	Ω	ohm	vtvm	vacuum tube voltmeter
h	henry	ppm	parts per million	var	variable
Hz	hertz	piv	peak inverse voltage	vhf	very high frequency
hf	high frequency	p-p	peak to peak	vlf	very low frequency
IC	integrated circuit	pf	picofarad	v	volt
if	intermediate frequency	plstc	plastic	va	voltampere
k	kilohm	p	pole	vac	volts, alternating current
kHz	kilohertz	pos	position	vdc	volts, direct current
kv	kilovolt	P/C	printed circuit	w	watt
lf	low frequency	rf	radio frequency	ww	wire wound

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
		AC/DC DIFFERENTIAL VOLTMETER						
		(line powered model)	883A					
		(battery-line powered model)	883AB					
		Front Panel Assembly (see Figure 5-2)						
		883A only	166066	89536	166066	1		
		883AB only	166157	89536	166157	1		
		Reference Supply Assembly (see Figure 5-3)	163220 (881A-403)	89536	163220	1		
		Null Detector Assembly (see Figure 5-4)	163212 (881A-402)	89536	163212	1		
		Kelvin-Varley Chassis Assembly (see Figure 5-5	162495 (881A-404)	89536	162495	1		
		Attenuator Assembly (S/N 123 thru 891) (see Figure 5-6)	166074 (883A-403)	89536	166074	1		
		Attenuator Assembly (S/N 892 and on) (see Figure 5-7)	195461 (887A-402)	89536	195461	1		
		Converter Assembly (see Figure 5-8)	166058 (883A-401)	89536	166058	1		
BT1		Battery, nickel-cadmium, 9.6v (883AB)	160408	06860	9.6v/500BH	4		
BT2		Battery, nickel-cadmium, 1.2v (883AB)	160390	06860	1.2 SC	4		
BT3		Battery, nickel-cadmium, 9.6v (883AB)	160408	06860	9.6v/500BH	REF		
C2		Cap, plstc, 0.47 uf ±20%, 1000v	161612	14752	210B1G474	1		
C3		Cap, cer, 0.1 uf, 500v	105684	52689	41C92	1		Y
CR1, CR2		Diode, silicon, 1 amp, 100 PIV (883AB)	116111	05277	IN4817	6	2	
F1		Fuse, 1/16 amp, slow blowing (for 115 volt operation)	163030	03614	Type MDL	1	2	
		Fuse, 1/32 amp, slow blowing (for 230 volt operation)	163022	03614	Type MDL	1	2	
J4,J5		Binding post, red	142976	58474	DF31RC	2		
P1,J6		Line Cord Assembly	161638	89536	161638	1		AL
		Line Cord Assembly	226100	91934	2270	1		AM
P2		Plug, 3 prong	160275	01730	M-1550-GS	1		AL
		Plug, 3 prong	222612	82389	AC3G	1		AM
R2,R3		Res, met film, 4.5M ±1%, 1w	159418	14298	CM-1	2		
R4		Res, met film, 900k ±1%, 1w	159509	72982	Type MF8C-TO	1		
R5		Res, met film, 90k ±1%, ½w	159426	72982	Type MF7C-TO	1		
R6		Res, met film, 9k ±1%, ½w	159434	72982	Type MF7C-TO	1		
R7		Res, met film, 1k ±1%, ½w	151324	72982	Type MF7C-TO	2		

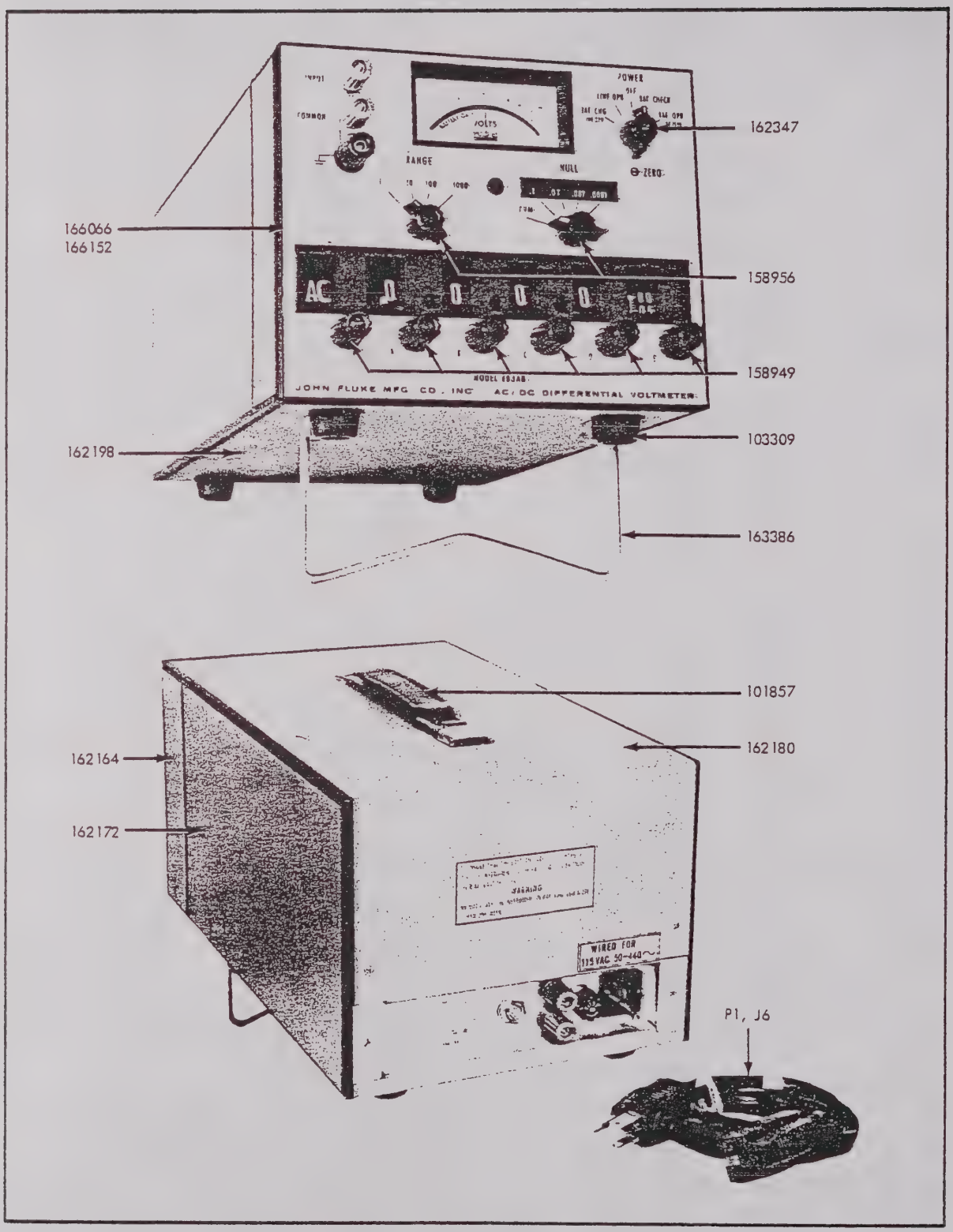


Figure 5-1. FINAL ASSEMBLY (Sheet 1 of 2)

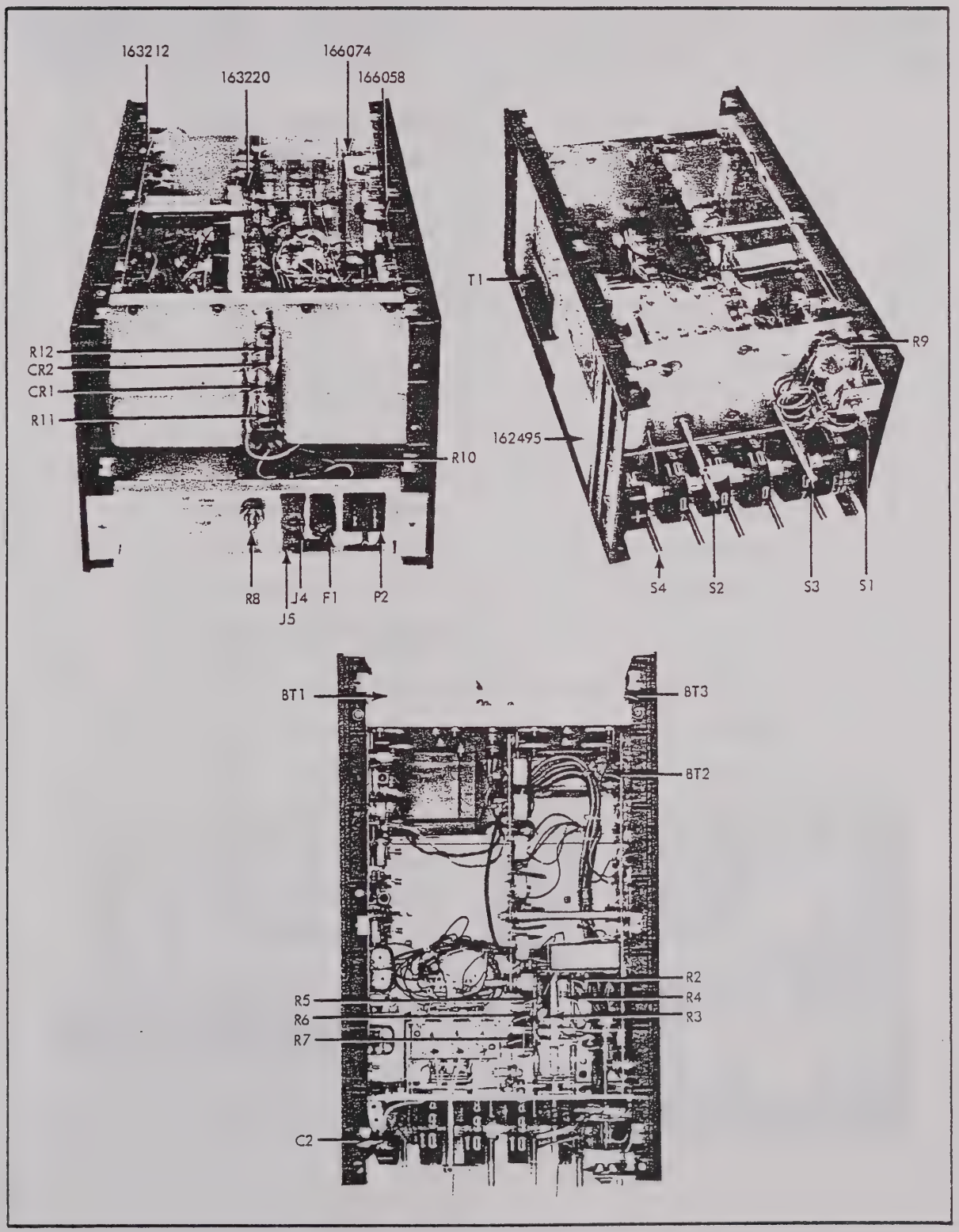


Figure 5-1. FINAL ASSEMBLY (Sheet 2 of 2)

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R8		Res, var, comp, 10k ±20%, ½w	162800	12697	Series 37	1		
R9		Res, comp, 62k ±5%, ½w (883AB)	108522	01121	EB6235	2		
R10		Res, comp, 10M ±10%, ½w	108142	01121	EB1061	1		
R11		Res, comp, 10Ω ±5%, 1w (883AB)	166298	01121	GB1005	1		
R12		Res, comp, 130Ω ±5%, 1w (883AB)	163055	01121	GB1315	2		
S1		SW, power (883A) SW, power (883AB)	162693 163360	89536 89536	162693 163360	1 1		
S2		SW, range	162719	89536	162719	1		
S3		SW, null	162669	89536	162669	1		
S4		SW, polarity	162701	89536	162701	1		
T1		Transformer	162818	89536	162818	1		
XF1		Fuse holder	160846	75915	342004	1		
		Cover, large side	162172	89536	162172	2		
		Cover, small side	162164	89536	162164	2		
		Cover, top-back	162180	89536	162180	1		
		Cover, bottom	162198	89536	162198	1		
		Handle	101857	12136	919-415-173	1		
		Knob, power	162347	89536	162347	1		
		Knob, polarity and voltage dials	158949	89536	158949	6		
		Knob, null and range	158956	89536	158956	2		
		Rubber foot Rubber foot	101253 103309	98388 83478	BH-2097 9102-W	4 4		F G
		Tilt stand	163386	89536	163386	1		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
		FRONT PANEL ASSEMBLY **Figure 5-2**						
		883A	166066	89536	166066	REF		
		883AB	166157	89536	166157	REF		
C1		Cap, plstc, 0.01 uf ±20%, 1000v	159996	84411	663UW103010W	1		
C4*		Cap, elec, 640 uf, −10%, +50%, 6.4v	178608	73445	C437ARC640	1		
J1 J2		Binding post, red	149856	58474	BHB-10208-G22	2		
J3		Binding post, black	142984	58474	DF31BC	1		
M1*		Meter, 100-0-100 ua, 900Ω (883A)	201236	89536	201236	1		
		Meter, 100-0-100 ua, 900Ω (883AB)	201244	89536	201244	1		
R1		Res, comp, 47k ±5%, ½w (not shown)	108738	01121	EB4735			A
R15*		Res, comp, 270Ω ±10%, ½w	108241	01121	EB2711	1		
		Shorting link	101220	24655	938L	1		
		Null Range Shutter	162263	89536	162263	1		
		Nylon Bushing	160499	96881	4L2-FF	9		
		* C4 and R15 are installed for external damping on Minn-Honeywell meters only.						

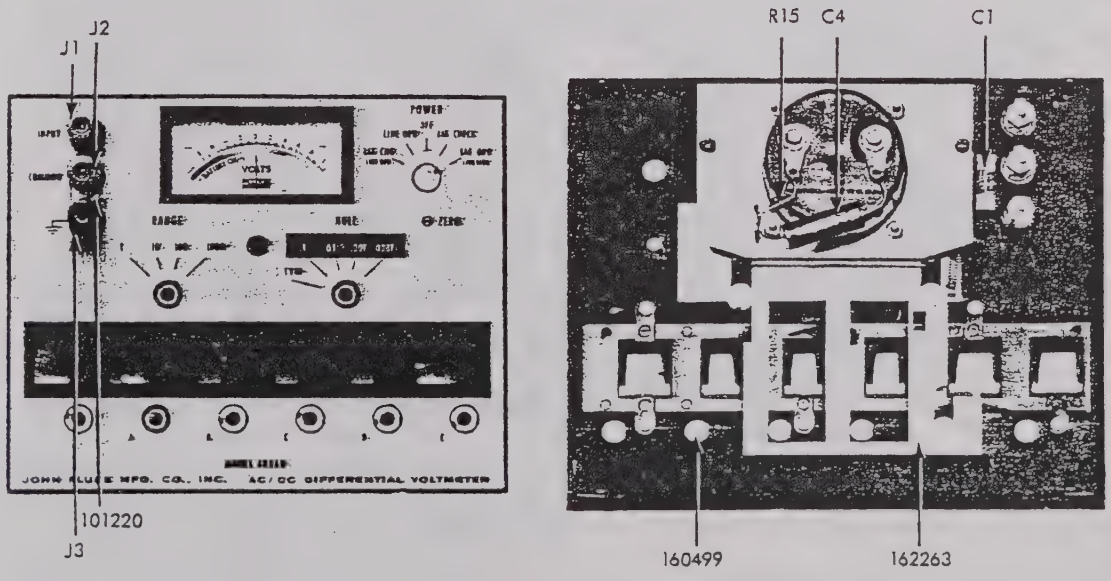


Figure 5-2. FRONT PANEL ASSEMBLY

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
		REFERENCE SUPPLY BOARD ASSEMBLY - Figure 5-3	163220 (881A-403)	89536	163220	REF		
C101		Cap, elect, 500 uf −10/+150%, 15v	160101	88419	BR500-15	1	1	
C102		Cap, elect, 150 uf −10/+150%, 50v	160119	88419	BR150-50	1	1	
C103		Cap, plstc, 0.022 uf ±10%, 75v	159400	56289	192P2239R75	1		
C104		Cap, plstc, 0.22 uf ±10%, 75v	159392	56289	192P2249R75	2		
C105, C106		Cap, Ta, 2.2 uf ±10%, 20v	160226	05397	K2R2C20K	5	2	
C107		Cap, plstc, 0.22 uf ±10%, 75v	159392	56289	192P2249R75	REF		
CR101		Diode, silicon, 1 amp, 100 PIV 883A	116111	05277	IN4817	4	1	
CR102		883AB	116111	05277	IN4817	REF		
Q101		Tstr, silicon, NPN	153551	07910	CDQ10449	–		D
		Tstr, silicon, NPN	117135	95303	2N2270	1	1	V
		Tstr, silicon, NPN	203489	07910	CDQ10656	8	3	U
Q102, Q103		Tstr, silicon, NPN	153551	07910	CDQ10449	8	3	T
		Tstr, silicon, NPN	203489	07910	CDQ10656	REF		U
Q104		Tstr, silicon, PNP	159491	73293	605-9			N
		Tstr, silicon, PNP	190389	04713	SM-4144	1	1	O
Q105		Tstr, germanium, PNP	163188	01295	2N404	1	1	
Q106, Q107		Tstr, germanium, NPN	1486431	01295	2N1307	2	1	
Q108, Q109		Tstr, germanium, NPN	117127	01295	2N1304	2	1	
R103		Res, var, ww, 10k ±10%, 2w	163147	71450	Type 118	1		
R105		Res, comp, 33Ω ±5%, 1w	163063	01121	GB3305	1		
R106		Res, comp, 330Ω ±5%, 1w	163394	01121	GB3315	1		
R107		Res, comp, 1M ±10%, ½w	108134	01121	EB1051	3		W
R110		Res var, ww, 500Ω ±10%, 1¼w	112433	71450	Type 110	1		
R111		Res, met flm, 23.2k ±1%, ½w	159459	75042	Type CEC-TO	2		
R112		Res, met flm, 8.06k ±1%, ½w	159467	75042	Type CEC-TO	1		
R113		Res, met flm, 10k ±1%, ½w	151274	75042	Type CEC-TO	1		
R114		Res, met flm, 23.2k ±1%, ½w	159459	75042	Type CEC-TO	REF		
R117		Res, comp, 10Ω ±10%, ½w	108092	01121	EB1001	1		
R119		Res, var, ww, 10Ω ±10%, 1¼w	112672	71450	Type 110	1		

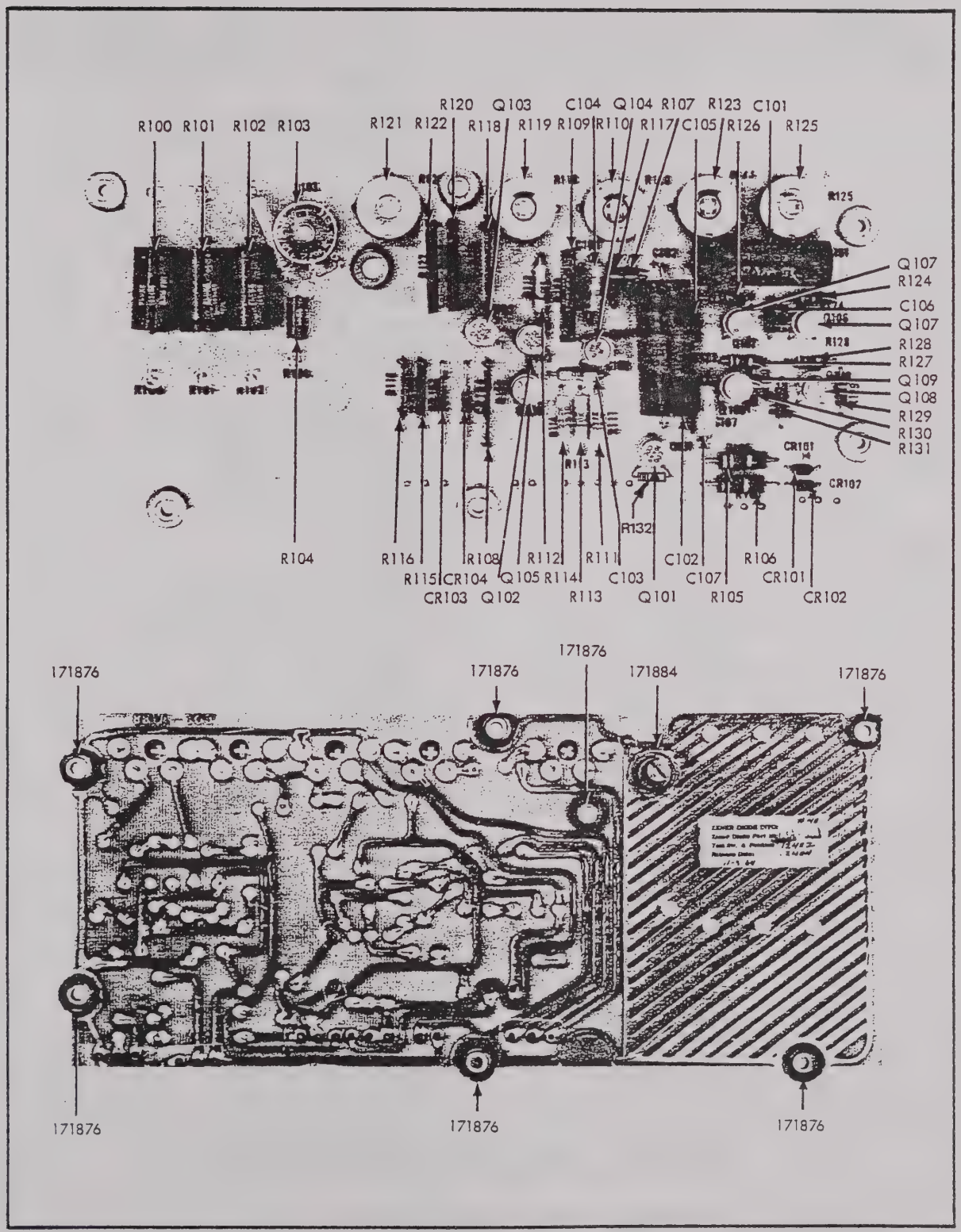


Figure 5-3. REFERENCE SUPPLY ASSEMBLY

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R121		Res, var, ww, 25Ω ±10%, 1¼w	161703	71450	Type 110	1		
R123		Res, var, ww, 1k ±20%, 1¼w	111575	71450	Type 110	3		
R124		Res, comp, 2.7k ±5%, ½w	109074	01121	EB2725	3		
R125		Res, var, ww, 1k ±20%, 1¼w	111575	71450	Type 110	REF		
R126		Res, comp, 2.7k ±5%, ½w	109074	01121	EB2725	REF		
R127, R128		Res, comp, 4.7k ±10%, ½w	108381	01121	EB4721	2		
R129, R130		Res, comp, 1k ±10%, ½w	108563	01121	EB1021	5		
R131		Res, comp. 82Ω ±5%, ½w	108746	01121	EB8205	1		AB
		Res, comp, 2.7Ω ±10%, ½w	108845	01121	EB27G1	1	1	AC
R132		Res, comp, 8.2k ±5%, ½w	147777	01121	EB8225	1		X
		Matched Zener-Res Set	162792	89536	162792	1	1	
CR103, CR104		Diode, Zener	2			2		
R108		Res, ww, 8k, 1w	1			1		
R109		Res, ww, 16.5k to 20.4k, 1w	1			1		
R115		Res, ww, 25 to 180Ω, 1/8w	1			–		N
		Res, ww, selected, ½w	1			1		O
R116		Res, ww, 650Ω ±0.1%, ½w	1			–		N
R118		Res, ww, 6k to 10k, 1w	1			1		
		Matched Input Divider Res Set	159848	89536	159848	1	1	
R100, R102		Res, ww, 3.3M, 1w	1			2		
R104		Res, ww, 100.05k, ¼w	1			1		
		Matched Range Divider Res Set	192195	89536	192195	1		
R120		Res, ww, 49.488k, 1w	1			1		
R122		Res, ww, 6.111k, 1w	1			1		
		Polyethelene grommet, 3/8 x 1/4	171876	89536	171876	17		
		Polyethelene grommet, 1/2 x 3/8	171884	89536	171884	1		

1 These resistors are factory matched for each instrument. When ordering, include all information stamped on resistor.

2 If replacement is required, the entire Zener-Resistor Set must be replaced.

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
		NULL DETECTOR BOARD ASSEMBLY - Figure 5-4	163212 (881A-402)	89536	163212	REF		
C201 to C203		Cap, plstc, .22 uf ±10%, 75v, coated with epoxy resin	162768	89536	162768	3		
C204		Cap, plstc, 0.047 uf ±20%, 100v	106096	84411	663UW47301	1		
C205		Cap, elect, 100 uf −10/+75%, 25v	106518	56289	30D107G025-DH4	3	1	AF
		Cap, elect, 50 uf +50/−10%, 25v	168823	73445	C426ARF50	2	1	AG
C206		Cap, elect, 40 uf −10/+75%, 6v	105205	56289	30D406G006-BB4	1	1	AF
		Cap, elect, 50 uf +50/−10%, 25v	168823	73445	C426ARF50	REF		AG
C207		Cap, elect, 5 uf −10/+75%, 25v	152009	56289	30D505G02-5BA4	2	1	AF
		Cap, plstc, 0.47 uf ±20%, 250v	184366	73445	C280AE/ P470K	1		AG
C208, C209		Cap, elect, 100 uf −10/+75%, 25v	106518	56289	30D107G02-5DH4	2	1	
C210		Cap, cer, 0.01 uf −20/+80%, 500v	105668	56289	29C9B5	3		
C211		Cap, elect, 200 uf −10/+75%, 6v	105189	56289	30D207G00-6DF4	1	1	
C212		Cap, plstc, 0.0047 uf ±20%, 200v	106054	84411	663UW47202	1		
C213		Cap, elect, 20 uf −10/+75%, 50v	106229	56289	30D206G05-0DC4	3	1	
C214		Cap, cer, 0.01 uf −20/+80%, 500v	105668	56289	29C9B5	REF		
C215		Cap, elect, 500 uf −10/+75%, 3v	106328	56289	30D507G00-3DH4	2	1	
C216		Cap, cer, 0.01 uf −20/+80%, 500v	105668	56289	29C9B5	REF		
C217		Cap, elect, 5 uf −10/+75%, 25v	152009	56289	30D505G02-5BA4	1	1	
C218		Cap, elect, 20 uf −10/+75%, 50v	106229	56289	30D206G05-0DC4	REF		
C219		Cap, elect, 500 uf −10/+75%, 3v	106328	56289	30D507G00-3DH4	REF		
C220		Cap, Ta, 2.2 uf ±10%, 20v	160226	05397	K2R2C20K	REF		
CR201, CR202		Diode, silicon, 150 ma, 6 PIV	113308	07910	CD13161	2	1	
DS201		Lamp, neon glow, type NE2E. 1/10w, coated with epoxy resin	162776	89536	162776	1	1	

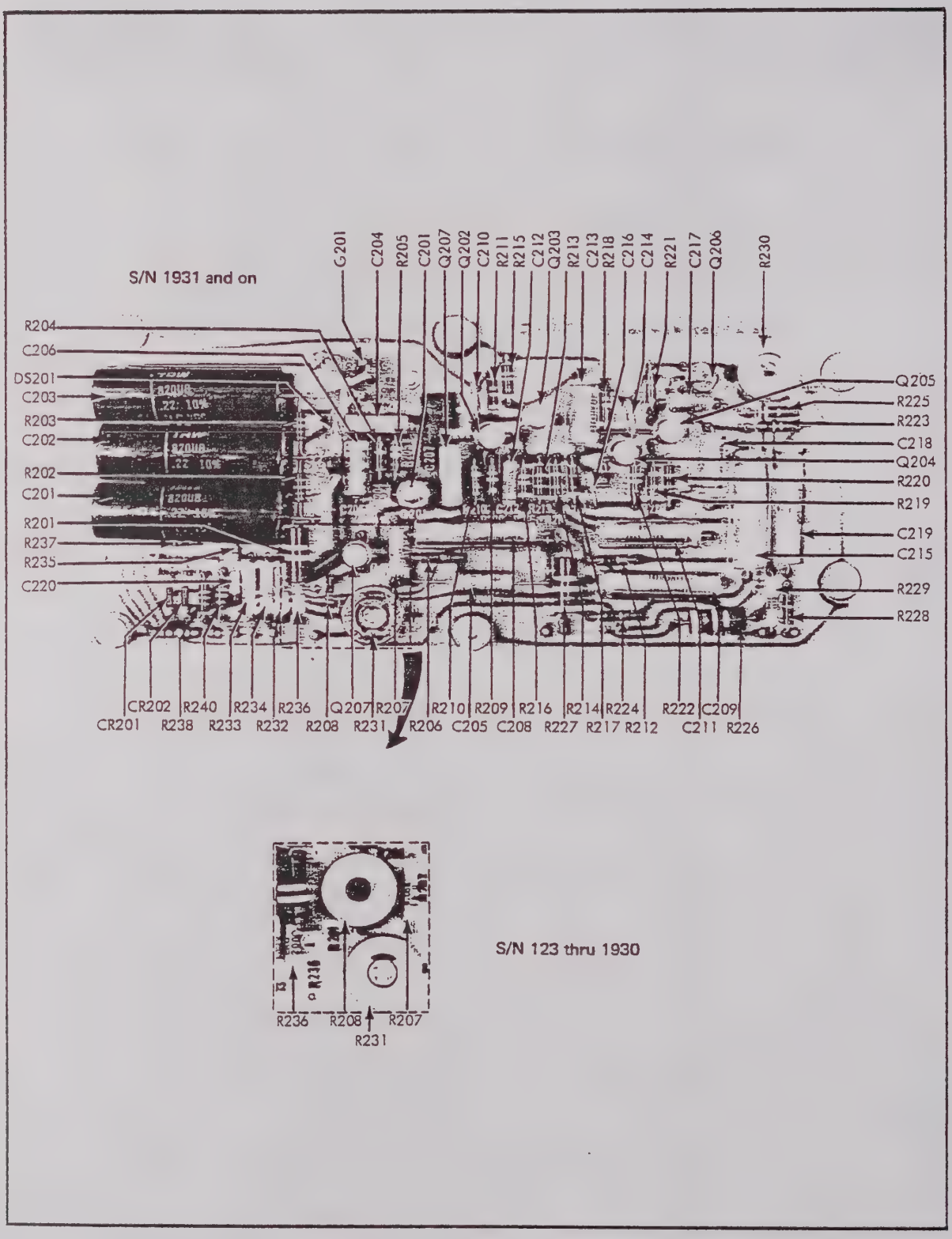


Figure 5-4. NULL DETECTOR ASSEMBLY

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
G201		Chopper, electromechanical, SPDT, coated with epoxy resin	162784	89536	162784	1	1	AB
		Chopper, electromechanical. SPDT,	218255	80640	CH1403/84	1	1	AC
Q201		Tstr, field effect, P-channel	159201	17856	U-112	1	1	Z
		Tstr, field effect, P-channel	216978	15818	P-1027	1	1	AA
Q202 to Q205		Tstr, silicon, NPN	153551	07910	CDQ10449	REF		T
		Tstr, silicon, NPN	203489	07910	CDQ10656	REF		U
Q206		Tstr, germanium, PNP	116129	01295	2N1372	1	1	
Q207		Tstr, silicon, PNP	242016	07263	SE4901	1	1	AG
R201		Res, comp, 220k ±10%, 2w	110197	01121	HB2241	1		
R202, R203		Res, comp, 220k ±10%, ½w	108217	01121	EB2241	2		
R204		Res, comp, 1M ±10%, ½w	108134	01121	EB1051	2		
R205		Res, comp, 22k ±10%, ½w	108209	01121	EB2231	4		
R206		Res, comp, 1k ±10%, ½w	108563	01121	EB1021	REF		AF
		Res, comp, 2k ±5%, ½w	169854	01121	EB2025	1		AG
R207		Res, met flm, 8.06k ±1%, ½w	159467	75042	Type CEC-TO	REF		AF
		Res, met flm, 15.8k ±1%, ½w	171983	75042	Type CEC-TO	1		AG
R208		Res, var, ww, 5k ±5%, 2w	111609	71450	Type 115	1		AF
		Res, comp, 33k ±5%, ¼w	148155	01121	CB3335	1		AG
R209		Res, comp, 10k ±10%, ½w	108118	01121	EB1031	2		
R210		Res, comp, 1.8k ±10%, ½w	108860	01121	EB1821	2		
R211		Res, comp, 47k ±10%, ½w	108480	01121	EB4731	2		
R212		Res, comp, 1k ±10%, ½w	108563	01121	EB1021	REF		
R213		Res, comp, 6.8k ±10%, ½w	108399	01121	EB6821	1		
R214		Res, comp, 180Ω ±10%, ½w	108571	01121	EB1811	1		
R215		Res, comp, 15k ±10%, ½w	108530	01121	EB1531	2		
R216		Res, comp 47k ±10%, ½w	108480	01121	EB4731	REF		
R217		Res, comp, 9.1k ±5%, ½w	160028	01121	EB9125	1		
R218		Res, comp, 27k ±10%, ½w	108878	01121	EB2731	2		
R219		Res, comp, 1.8k ±10%, ½w	108860	01121	EB1821	REF		
R220		Res, comp, 39Ω ±10%, ½w	160036	01121	EB3901	1		
R221		Res, comp, 7.5k ±5%, ½w	108910	01121	EB7525	1		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R222		Res, comp, 22k ±10%, ½w	108209	01121	EB2231	REF		
R223		Res, comp, 10k ±10%, ½w	108118	01121	EB1031	REF		
R224		Res, comp, 1k ±10%, ½w	108563	01121	EB1051	REF		
R225		Res, comp 3.9k ±10%, ½w	161406	01121	EB3921	1		
R226, R227		Res, comp, 47k ±10%, 2w	110015	01121	HB4731	2		
R228		Res, comp, 1.5k ±10%, ½w	108159	01121	EB1521	1		
R229		Res, met flm, 453Ω ±1%, ½w	155051	75042	Type CEC-TO	1		
R230		Res, var, ww, 100Ω ±20%, 1¼w	112797	71450	Type 110	1		
R231		Res, var, ww, 10k ±5%, 2w	112862	71450	Type 110	2		
R232		Res, met flm, 90.9k ±1%, ½w	162974	75042	Type CEC-TO	1		
R233		Res, met flm, 909k ±1%, ½w	159483	75042	Type CEC-TO	1		
R234		Res, met flm, 1k ±1%, ½w	151324	72982	Type MF7C-TO	REF		
R235		Res, met flm 8.45k ±1%, ½w	159475	75042	Type CEC-TO	1		
R236		Res, met flm, 200Ω ±1%, ½w	151480	75042	Type CEC-TO	1		
R237		Res, comp, 6.8M ±10%, ½w	108662	01121	EB6851	1		
R238		Res, comp, 56k ±10%, ½w	108472	01121	EB5631	1		
R239		Res, var, comp, 100k ±30%, 3/10w	163402	71450	Type 70	1		
R240		Res, comp, 180k ±10%, ½w	108431	01121	EB1841	1		
		Polyethylene grammet, 3/8 x 1/4	171876	89536	171876	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
		KELVIN-VARLEY ASSEMBLY Figure 5-5	162495 (881A-404)	89536	162495	REF		
C301		Cap, plstc, 1 uf ±10%, 200v	106450	84411	663UW10502	1		
R13		Res, var, ww, 2.5k ±0.5%	163154	89536	163154	1		
R302		Res, met flm, 9.53k ±1%, ½w	159442	75042	Type CEC-TO	1		
R303		Res, var, ww, 1k ±20%, 1¼w	111575	71450	Type 110	REF		
R304 to R314		Res, ww, 1k, ½w	1	89536		33		
R315		Res, ww, 2,499Ω, ½w	1	89536		2		
R316		Res, var ww, 2Ω ±10%, 2w	153445	71450	Type 115	9		
R317 to R327		Res, ww, 1k, ½w	1	89536				
R328		Res, ww, 2,499Ω, ½w	1	89536				
R329		Res, var ww, 2Ω ±10%, 2w	153445	71450	Type 115	REF		
R330 to R340		Res, ww, 1k, ½w	1	89536				
Odd no. from R341 to R363		Res, ww, 4,999.2Ω ±0.01%, 1w	1	89536		12		
Even no from R342 to R354		Res, var ww, 2Ω ±10%, 2w	153445	71450	Type 115	REF		
Even no from R356 to R364		Res, var, ww, 2Ω ±10%, 2w Res, var, ww, 2Ω ±10%, 2w	153445 182410	71450 89536	Type 115 182410	REF 5		H I
S5		Sw, voltage dial A	162644	89536	162644	1		
S6		Sw, voltage dial B	162636	89536	162636	2		
S7		Sw, voltage dial C	162651	89536	162651	1		
S8		Sw, voltage dial D	162636	89536	162636	REF		
		Polyethelene grommet 3/8 x 1/4	171876	89536	171876	REF		

1 These resistors are factory matched for each instrument. When ordering, include all information stamped on resistor.

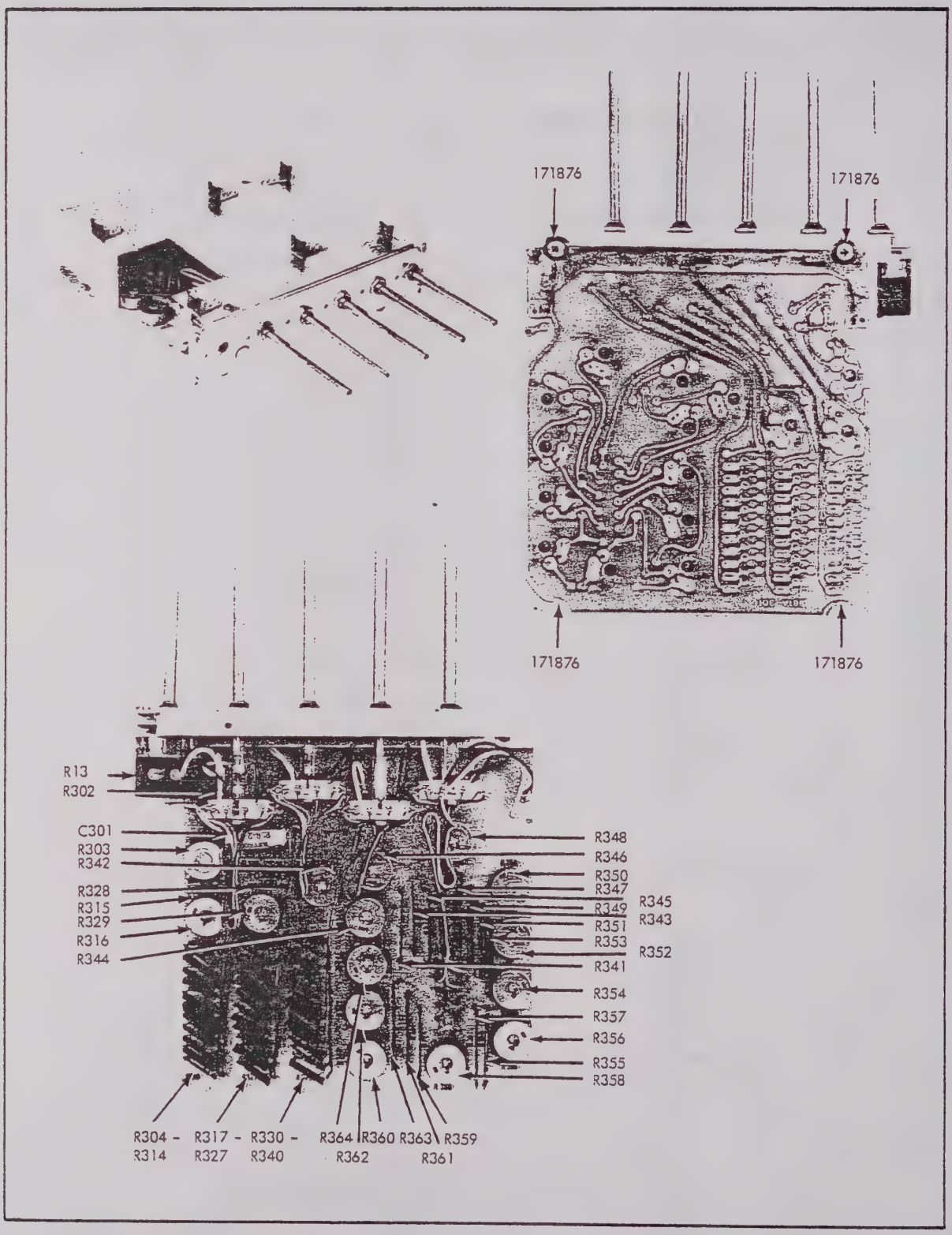


Figure 5-5. KELVIN-VARLEY ASSEMBLY

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
		NOTE: This assembly used in Models 883A and 883AB, serial numbers 123 through 891 only.						
		ATTENUATOR ASSEMBLY **Figure 5-6**	166074	89536	166074			
		Resistor Set	166884	89536	166884	-		B
		Resistor Set	159814	89536	159814	1		C
R401		Res, met flm, 900k	1					
R402		Res, met flm, 109k	1					
		Resistor Set	166892	89536	166892	-		B
		Resistor Set	159830	89536	159830	1		C
R404		Res, met flm, 990k	1					
R405		Res, met flm, 9.88k	1					
		Resistor Set	166900	89536	166900	-		B
		Resistor Set	159806	89536	159806	1		C
R407, R408		Res, met flm, 500k	1					
R409		Res, met flm, 976Ω	1					
C401		Cap, var glass, 1.0 to 8.5 pf, 1000v specially treated.	166868	89536	166868	-		P
		Cap, var alumina, 1.0 to 10 pf, 400v	188698	91293	JMC2903	4		Q
C402		Cap, cer, 33 pf ±10%, 100v	159954	95275	VY10CA330KA	1		
C403		Cap, var glass, 1.0 to 8.5 pf, 1000v specially treated.	166868	89536	166868	-		P
		Cap, var alumina, 1.0 to 10 pf, 400v	188698	91293	JMC2903	REF		Q
C404		Cap, cer, 390 pf ±10%, 100v	159962	95275	VY15CA391KA	1		
C405		Cap, var glass, 1.0 to 8.5 pf, 1000v specially treated.	166868	89536	166868	-		P
		Cap, var alumina, 1.0 to 10 pf, 400v	188698	91293	JMC2903	REF		Q
C406		Cap, cer, 5.0 pf ±10%, 500v specially treated.	166843	89536	166843	-		P
		Cap, cer, 5.0 pf ±5%, 1100v	187682	00656	Type C1-2	2		Q
C407		Cap, mica, 3000 pf ±5%, 100v	161786	88419	CD19F302J	1		
R403		Res, var ww, 5k ±10%, 1w	159905	80740	55PR5K	1		
R406		Res, var, met flm, 500Ω ±10%, 1w	159897	80740	55PR500	1		
R410		Res, var, met flm, 100Ω ±10%, 1w	159889	80740	55PR100	1		
R411		Res, comp, 33k ±5%, ½w	108761	01121	EB3335	1		Q

1 Factory selected. If replacement is required, replace with the appropriate resistor set.

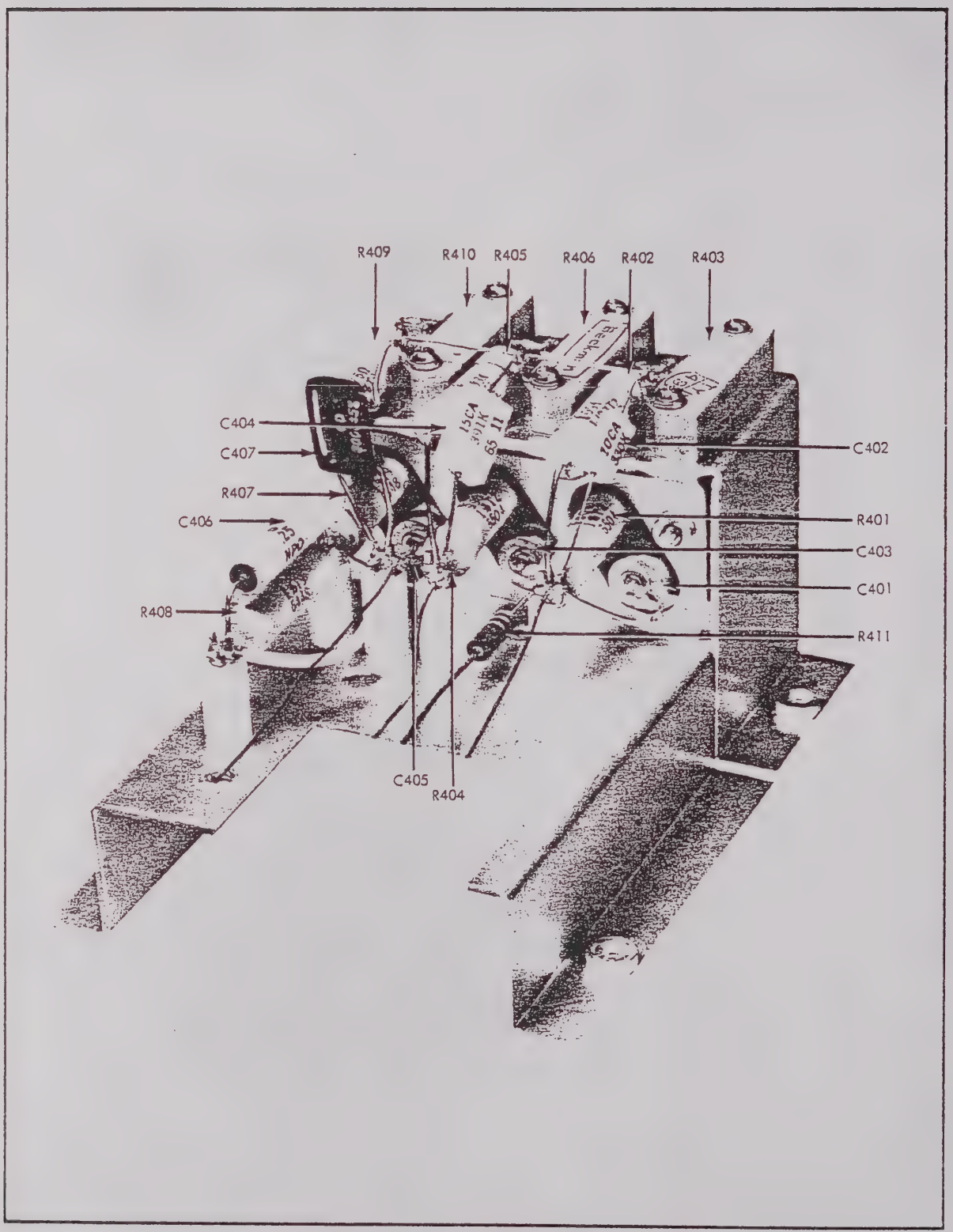


Figure 5-6. ATTENUATOR ASSEMBLY (S/N 123 thru 891)

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
		NOTE: This assembly used in the Models 883A and 883AB beginning with serial number 892.						
		ATTENUATOR ASSEMBLY Figure 5-7	195461 (887A-402)	89536	195461	REF		
		Resistor Set	159814	89536	159814	1		
R401		Res. met flm, 900k		89536				
R402		Res, met flm, 109k		89536				
		Resistor Set	159830	89536	159830	1		
R404		Res, met flm, 990k		89536				
R405		Res, met flm, 9.88k		89536				
		Resistor Set	159806	89536	159806	1		
R407, R408		Res, met flm, 500k		89536				
R409		Res, met flm, 976Ω		89536				
C401		Cap, var, trimmer, 1 to 10 pf, 400v	188698	91293	JMC2903	3		
C402		Cap, cer, 15 pf ±10%, 500v	159947	00656	Type C1-1	1		
C403		Cap, var, trimmer, 1 to 10 pf, 400v	188698	91293	JMC2903	REF		
C404		Cap, mica, 150 pf ±5%, 500v	148478	88419	CD15F151J	1		
C405		Cap, var, trimmer, 1 to 10 pf, 400v	188698	91293	JMC2903	REF		
C406		Cap, cer, 5.0 pf ±5%, 1100v	187682	00656	Type C1-2	2		
C407		Cap, mica, 3,000 pf ±5%, 500v (factory selected nominal)	161786	88419	CD19F302J	1		
R403		Res, var, met flm, 5k ±20%, 3/4w	159905	80740	Type 78P	1		
R406		Res, var, met flm, 500Ω ±20%, 3/4w	159897	80740	Type 78P	1		
R410		Res, var, met flm, 100Ω ±20%, 3/4w	159889	80740	Type 78P	1		
R411		Res, comp, 82k ±5%, ¼w	188458	01121	CB8235	1		

Factory selected. If replacement is required, replace with new Resistor Set.

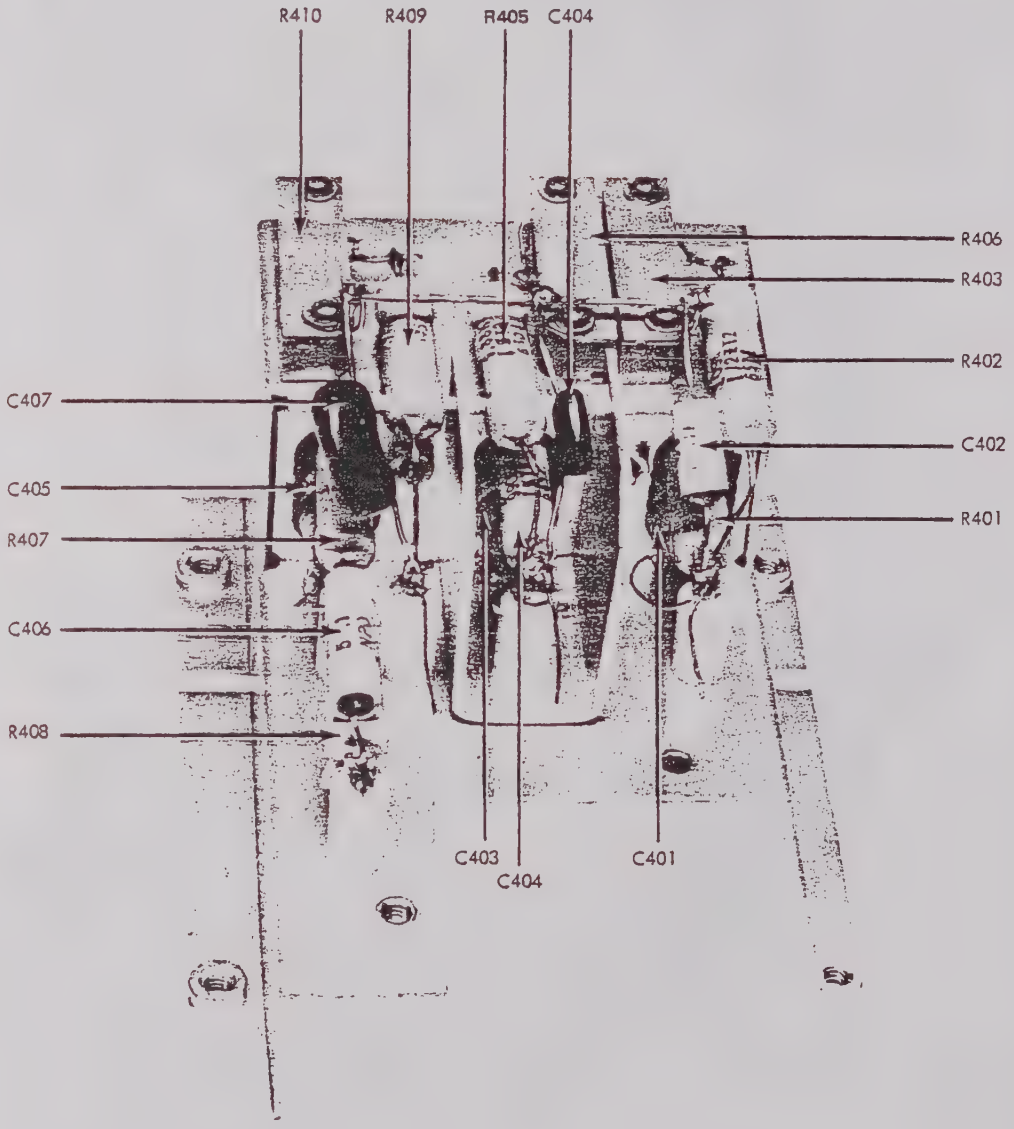


Figure 5-7. ATTENUATOR ASSEMBLY (S/N 892 and on)

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
		CONVERTER BOARD ASSEMBLY Figure 5-8	166058 (883A-401)	89536	166058			
C501		Cap, cer, 5.1 pf ±10%, 500v	166843	89536	166843	-		R
		Cap, cer, 5.0 pf ±5%, 1100v	187682	00656	Type C1-2	REF		S
C502		Cap, var glass, 0.8 to 8.5 pf, 1250v specially treated.	166850	89536	166850	-		R
		Cap, var alumina, 1.0 to 10 pf, 400v	188698	91293	JMC2903	REF		S
C503		Cap, cer, 15 pf ±10%, 500v specially treated.	166876	89536	166876	-		R
		Cap, cer, 15 pf ±10%, 500v	159947	00656	Type C1-1	1		S
C504		Cap, plstc, 5 uf ±20%, 60v	160952	72928	364W-505M	1		
C505		Cap, elect, 30 uf +75/−10%, 15v	106492	56289	30D306G-015CB4	1	1	
C506		Cap, elect, 250 uf +75/−10%, 12v	160002	56289	30D275G-012DH4	2	1	
C507		Cap, mica, 33 pf ±5%, 500v	160317	88419	CD15E330J	1		
C508		Cap, Ta, 68 uf ±20%, 6v	160242	05397	K68P6	1	1	
C509		Cap, mica 22 pf ±5%, 500v	148551	88419	CD15E220J	1		AD
		Cap, mica, 10 pf ±10%, 500v	175216	88419	CD15C0100K	1	1	AE
C510		Cap, elect, 250 uf +75/−10%, 12v	160002	56289	30D275G-012DH4	REF		
C511		Cap, Ta, 10 uf ±10%, 20v	160259	05397	K10C20K	1	1	
C512		Cap, plstc, 0.001 uf ±10%, 200v	159582	56289	192P10292	1		
C513		Cap, Ta, 2.2 uf ±10%, 20v	160226	05397	K2R2C20K	REF		
C514		Cap, Ta, 150 uf ±10%, 6v	160234	05397	K150C6K	1	1	
C516		Cap, plstc, 0.00047 uf ±10%, 200v	159574	56289	192P47192	1		AD
		Cap, mica, 1500 pf ±5%, 500v	148361	88419	CD19F152J	1	1	AE
C517		Cap, Ta, 150 uf +20/−15%, 15v	160945	56289	109D157C-2015TO	1	1	
C518, C519		Cap, plstc, 2 uf ±20%, 10v	160960	00656	V-146-ZR	2		Z
		Cap, plstc, 2 uf ±10%, 200v	106443	84411	Type X663F	2		AA
C520		Cap, elect, 50 uf +75/−10%, 50v	105122	56289	30D506G-050DD4	1	1	
C521		Cap, Ta, 2.2 uf ±10%, 20v	160226	05397	K2R2C20K	REF		
C522		Cap, elect, 30 uf +75/−10%, 15v	106492	56289	30K306G-015CB4	1	1	
C523		Cap, elect, 20 uf +75/−10%, 50 v	106229	56289	30D206G-050DC4	REF		
CR501		Diode, silicon, 10 ma 20 PIV	161810	03877	SG5337	1	1	AJ
		Diode, silicon, 100 ma @ 1.5v, 40 PIV	261370	22767	S1330	1		AK

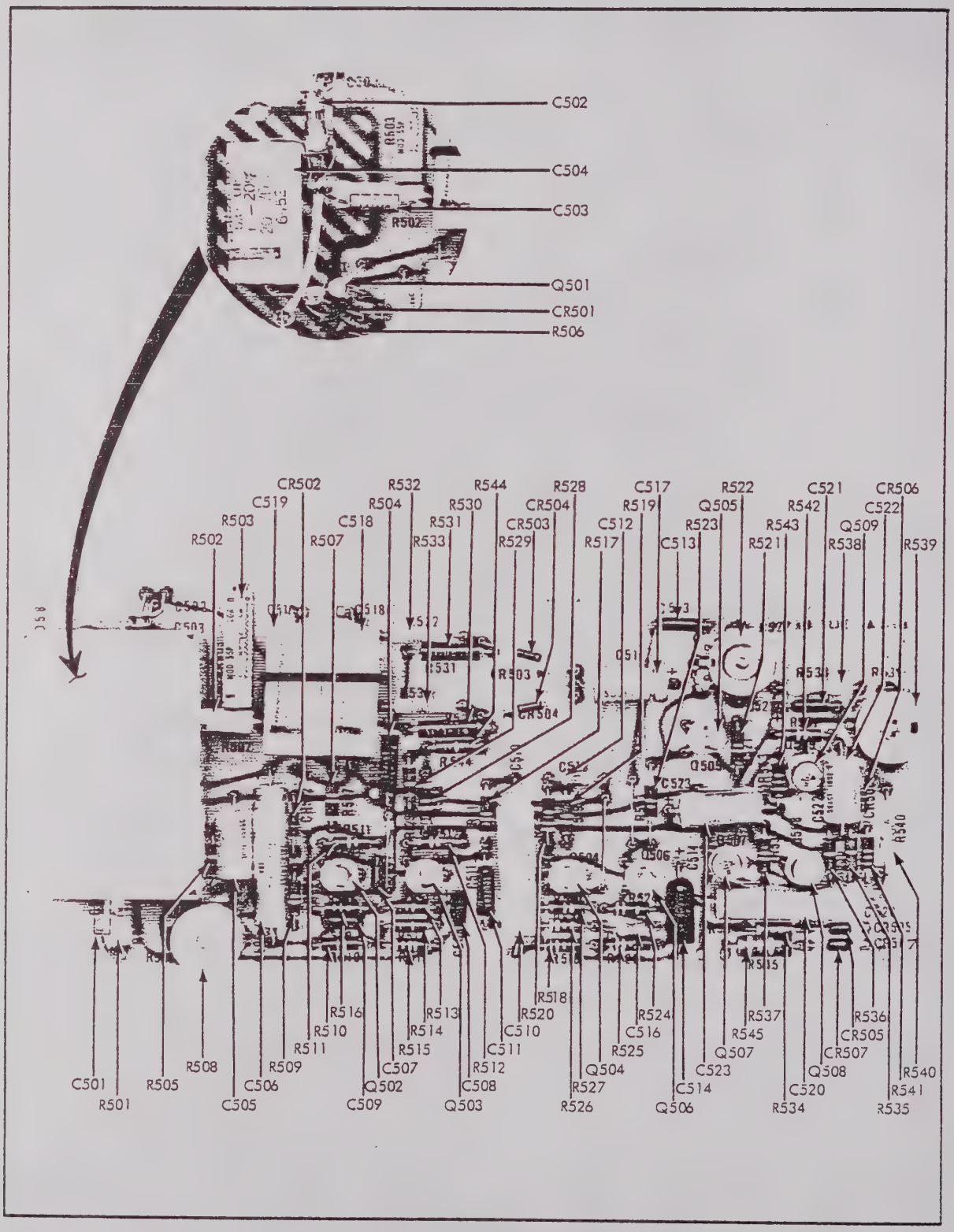


Figure 5-8. CONVERTER ASSEMBLY

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
CR502		Diode, Zener, 6.8v at 20 ma	166199	07910	1N754	-		L
		Diode, Zener, 6.8v at 1 ma	187195	07910	CD36554	2	1	M
		Diode, Zener, 6.2v at 1 ma	180497	07910	1N753	1	1	AE
CR503, CR504		Diode, silicon, 10 ma, 20 PIV	161810	03877	SG5337	2	1	
CR505		Diode, silicon, 1 amp, 100 PIV	116111	05277	1N4817	REF		
CR506		Diode, Zener, 6.8v at 20 ma	166199	07910	1N754			L
		Diode, Zener, 6.8v at 1 ma	187195	07910	1N754	1		M
CR507		Diode, silicon, 1 amp, 100 PIV	116111	05277	1N4817	REF		
Q501		Tstr, field effect, N-channel	166223	15818	U-1249	1	1	
Q502		Tstr, silicon, NPN	159855	07910	CDQ23102	1		AD
		Tstr, silicon, NPN	218081	04713	MPS6520	1	1	AE
Q503 to Q506		Tstr, silicon, NPN	159855	07910	CDQ23102	4	1	
Q507		Tstr, silicon, PNP	159491	73293	605-9	-		N
		Tstr, silicon, PNP	190389	04713	SM-4144	REF		AH
		Tstr, silicon, PNP	246462	07263	2N4356	2	1	AI
Q508		Tstr, silicon, NPN	153551	07910	CDQ10449	REF		T
		Tstr, silicon, NPN	203489	07910	CDQ10656	REF		U
Q509		Tstr, silicon, PNP	159491	73293	605-9	-		N
		Tstr, silicon, PNP	190389	04713	SM-4144	REF		AH
		Tstr, silicon, PNP	246462	07263	2N4356	REF		AI
		Resistor Set, matched and specially treated.	166918	89536	166918	-		B
		Res. Set, matched	159822	89536	159822	1		C
R501		Res, ww, 1M ±1%, 1w	1					
R502		Res, ww, 246k ±1/2%, 1w	1					
R503		Res, var met flm, 10k ±10%, 1w	159913	80740	55PR10K	1		
R504		Res, ww, 125Ω ±1%, ¼w	159764	15909	Type R1136	1		
R505		Res, comp, 1k ±10%, ½w	108563	01121	EB1021	REF		C
R506		Res, comp, 1M ±10%, ½w	108134	01121	EB1051	REF		
R507		Res, comp, 22k ±10%, ½w	108209	01121	EB2231	REF		
R508		Res, var, ww, 10k ±20%, 1¼w	112862	71450	Type 110	REF		
R509		Res, comp, 10k ±5%, ½w	109165	01121	EB1035	4		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R510		Res, comp, 56k ±10%, ½w	108472	01121	EB5631	REF		AD
		Res, comp, 33k ±10%, ½w	178541	01121	EB3331	1		AE
R511		Res, comp, 16k ±5%, ½w	159632	01121	EB1635	1		
R512		Res, comp, 10k ±5%, ½w	109165	01121	EB1035	REF		
R513		Res, comp, 270Ω ±5%, ½w	159616	01121	EB2715	1		
R514		Res, comp, 2.7k ±5%, ½w	109074	01121	EB2725	REF		
R515		Res, comp, 8.2Ω ±5%, ½w	159590	01121	EB82G5	1		
R516		Res, comp, 68k ±5%, ½w	159624	01121	EB6835	1		
R517		Res, comp, 27k ±10%, ½w	108878	01121	EB2731	REF		
R518		Res, comp, 3.3k ±10%, ½w	108373	01121	EB3321	1		
R519		Res, comp, 15k ±10%, ½w	108530	01121	EB1531	REF		
R520		Res, comp, 470Ω ±5%, ½w	108787	01121	EB4715	2		
R521		Res, comp, 62k ±5%, ½w (883A)	108522	01121	EB6235	1		
		Res, comp, 62k ±5%, ½w (883AB)	108522	01121	EB6235	1		
R522		Res, var, comp, 100k ±30%, ½w	160010	71450	Type UPE70	1		
R523		Res, comp, 300Ω ±5%, ½w	108829	01121	EB3015	1		
R524		Res, comp, 47Ω ±5%, ½w	159608	01121	EB4705	1		
R525		Res, comp, 470Ω ±5%, ½w	108787	01121	EB4715	REF		
R526		Res, comp, 330Ω ±5%, ½w	108936	01121	EB3315	2		AD
		Res, comp, 150Ω ±5%, ½w	186056	01121	EB1515	1		AE
R527		Res, comp, 10k ±5%, ½w	109165	01121	EB1035	REF		
R528		Res, comp, 100k ±10%, ½w	108126	01121	EB1041	1		
R529		Res, comp, 5.6k ±10%, ½w	108324	01121	EB5621	-		J
		Res, comp, 2.7k ±10%, ½w	108837	01121	EB2721	1		K
R530, R531		Res, ww, 547Ω ±0.1%, ¼w	159772	15909	Type R1136	2	1	
R532, R533		Res, met film, 51.1k ±1%, ½w	159665	75042	Type CEC-TO	2		
R534		Res, comp, 330Ω ±5%, ½w	108936	01121	EB3315	1		
R535		Res, comp, 2.2k ±5%, ½w	108506	01121	EB2225	1		
R536		Res, comp, 1.5M ±10%, ½w	108175	01121	EB1551	1		
R537		Res, comp, 22k ±10%, ½w	108209	01121	EB2231	REF		
R538		Res, met film, 10k ±10%, ½w	151274	75042	Type CEC-TO	1		
R539		Res, var, ww, 3k ±20%, 2w	153429	71450	Type 115	1		
R540		Res, met film, 5.11k ±1%, ½w	159657	75042	Type CEC-TO	1		
R541		Res, comp, 1.1Ω ±5%, ½w	163717	01121	EB11G5	1		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R542		Res, comp, 10k ±5%, ½w	109165	01121	EB1035	REF		
R543		Res, comp, 24k ±5%, ½w	108654	01121	EB2435	1		
R544		Res, comp, 22M ±10%, ½w	108233	01121	EB2261	1		
R545		Res, comp, 130Ω ±5%, 1w	163055	01121	GB1315	REF		

1 These resistors are factory matched for each instrument. When ordering, include all information stamped on resistor.

5-9. SERIAL NUMBER EFFECTIVITY

5-10. A Use Code column is provided to identify certain parts that have been added, deleted, or modified during production of the Model 883A. Each part for which a use code has been assigned may be identified with a particular instrument serial number by consulting the Use Code Effectivity List below. All parts with no code are used on all instruments with serial numbers above 123.

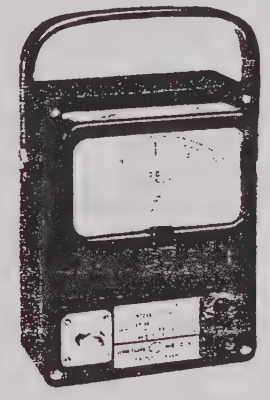
USE CODE	EFFECTIVITY
No Code	Model 883A & 883AB serial number 123 and on
A	Model 883A & 883AB serial number 123 to 127
B	Model 883A & 883AB serial number 123 to 147
C	Model 883A & 883AB serial number 148 and on
D	Model 883A & 883AB serial number 123 to ~ 150
E	Model 883A & 883AB serial number ~ 151 and on
F	Model 883A & 883AB serial number 123 to ~ 200
G	Model 883A & 883AB serial number ~ 201 and on
H	Model 883A & 883AB serial number 123 to ~ 351
I	Model 883A & 883AB serial number ~ 352 and on
J	Model 883A & 883AB serial number 123 to 375
K	Model 883A & 883AB serial number 376 and on
L	Model 883A & 883AB serial number 123 to 514
M	Model 883A & 883AB serial number 515 and on
N	Model 883A & 883AB serial number 123 to ~ 550
O	Model 883A & 883AB serial number ~ 551 and on
P	Model 883A & 883AB serial number 123 to 569
Q	Model 883A & 883AB serial number 570 and on
R	Model 883A & 883AB serial number 123 to 589
S	Model 883A & 883AB serial number 590 and on
T	Model 883A & 883AB serial number 123 to 750
U	Model 883A & 883AB serial number 751 and on
V	Model 883A & 883AB serial number ~ 151 to 750
W	Model 883A & 883AB serial number 123 to 920
X	Model 883A & 883AB serial number 921 and on
Y	Model 883A & 883AB serial number 751 to 931
Z	Model 883A & 883AB serial number 123 thru 1200
AA	Model 883A & 883AB serial number 1201 and on
AB	Model 883A & 883AB serial number 123 thru 1560
AC	Model 883A & 883AB serial number 1561 and on
AD	Model 883A & 883AB serial number 123 thru 1630
AE	Model 883A & 883AB serial number 1631 and on
AF	Model 883A & 883AB serial number 123 thru 1930
AG	Model 883A & 883AB serial number 1931 and on
AH	Model 883A & 883AB serial number 551 thru 1955
AI	Model 883A & 883AB serial number 1956 and on
AJ	Model 883A & 883AB serial number 123 thru 2105
AK	Model 883A & 883AB serial number 2106 and on
AL	Model 883A & 883AB serial number 123 thru 2321
AM	Model 883A & 883AB serial number 2322 and on

SECTION VI

ACCESSORIES

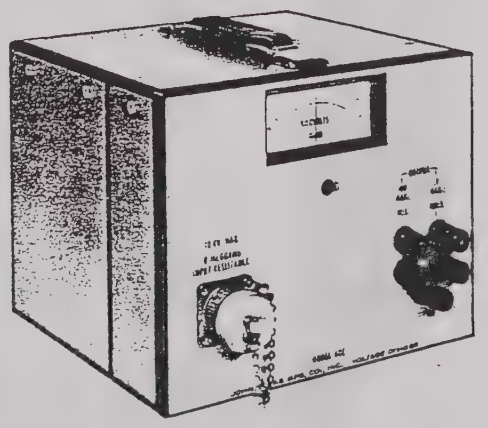
6-1. PRECISION VOLTAGE DIVIDERS

6-2. The FLUKE 80A, 80D, and 80E Voltage Dividers provide the FLUKE 800 Series Differential Voltmeters with the ability to make high accuracy measurements up to 30,000 volts DC. All models contain a zero center panel meter which allows the polarity and approximate magnitude of the unknown high voltage to be easily observed. At maximum input, all units draw but 1 ma of current from the unknown. The extreme accuracy and excellent long term stability of these dividers are obtained by using properly aged precision wirewound resistors which have a very low temperature coefficient. To further ensure high accuracy and long term stability at very high voltages, the 80D dividers have all resistance components immersed in oil within a hermetically sealed container. As an additional feature, all 80D and 80E models are provided with a 1 volt tap which allows measurements of high voltages with a laboratory potentiometer. Specifications for the standard models are shown on next page. Other intermediate models are available upon special request.



MODEL 80A

MODEL 80D



MODEL 80E

Model No.	Maximum Input Voltage	Total Resistance	Current Drawn At Max. Input	Division Ratio			Division Ratio Accuracy	Stability of Division Accuracy Per Year
				500V Out	10V Out	1V Out		
80A-1	1 KV	1 M	1 ma	2:1	——	——	±0.015%	——
80A-2	2 KV	2 M	1 ma	4:1	——	——	±0.015%	——
80E-5	5 KV	5 M	1 ma	—	500:1	5,000:1	±0.01%	±0.01%
80E-10	10 KV	10 M	1 ma	—	1000:1	10,000:1	±0.01%	±0.01%
80D-30	30 KV	30 M	1 ma	60:1	3000:1	30,000:1	±0.01%	±0.01%

MODELS	SIZE	INPUT CONNECTOR	OUTPUT CONNECTOR
80A	6-3/4" high 5-1/4" wide 2-1/4" deep	UG-560U with mating connector supplied	Insulated binding posts on 3/4" centers
80E	7" high 8-1/2" wide 8" deep	MS3102A-18-165 with mating connector supplied	Insulated binding posts on 3/4" centers for both outputs
80D	13" high 9-3/4" wide 16" deep	Special 5" ceramic standoff with mating 6" guard supplied	Insulated binding post on 3/4" centers for both outputs

MODEL A88 ISOLATION AMPLIFIER

6-3. ISOLATION AMPLIFIER

6-4. The FLUKE Model A88 all solid-state isolation amplifier is designed to provide isolation between the output of a differential voltmeter and the input of a recorder. Thus, the A88 will allow the use of a wide range of strip chart recorders for recording the voltmeter reading without regard to the input isolation characteristics of the recorder. The A88 is also excellent for making accurate dc microvolt and nanoampere measurements in the presents of common mode voltages up to 1100 vdc and 3 vac, 50 to 500 cycles.

GAIN: 1 volt output per microampere input.

GAIN ACCURACY: ±2%.

INPUT CURRENT RANGE: 0 to 2 microamperes.

INPUT VOLTAGE RANGE: 0 to 2 millivolts nominal.

INPUT RESISTANCE: 950 ohms (±5%).

OUTPUT VOLTAGE RANGE: 0 to 2 volts open circuit.

OUTPUT RESISTANCE: 1000 ohms (±5%).

INPUT ISOLATION FROM CHASSES: Greater than 5×10^{11} ohms at 25°C (77°F), 60% RH and 1×10^{10} ohms at 50°C (122°F), 80% RH.

Section 7

General Information

7-1. This section of the manual contains generalized user information as well as supplemental information to the List of Replaceable Parts contained in Section 5.

List of Abbreviations and Symbols

A or amp	ampere
ac	alternating current
af	audio frequency
a/d	analog-to-digital
assy	assembly
AWG	american wire gauge
B	bel
bcd	binary coded decimal
°C	Celsius
cap	capacitor
ccw	counterclockwise
cer	ceramic
cermet	ceramic to metal(seal)
ckt	circuit
cm	centimeter
cmrr	common mode rejection ratio
comp	composition
cont	continue
crt	cathode-ray tube
cw	clockwise
d/a	digital-to-analog
dac	digital-to-analog converter
dB	decibel
dc	direct current
dmm	digital multimeter
dvm	digital voltmeter
elect	electrolytic
ext	external
F	farad
°F	Fahrenheit
FET	Field-effect transistor
ff	flip-flop
freq	frequency
FSN	federal stock number
g	gram
G	giga (10^9)
gd	guard
Ge	germanium
GHz	gigahertz
gmv	guaranteed minimum value
gnd	ground
H	henry
hd	heavy duty
hf	high frequency
Hz	hertz
IC	integrated circuit
if	intermediate frequency
in	inch(es)
intl	internal
I/O	input/output
k	kilo (10^3)
kHz	kilohertz
kΩ	kilohm(s)
kV	kilovolt(s)
lf	low frequency
LED	light-emitting diode
LSB	least significant bit
LSD	least significant digit
M	mega (10^6)
m	milli (10^{-3})
mA	milliampere(s)
max	maximum
mf	metal film
MHz	megahertz
min	minimum
mm	millimeter
ms	millisecond
MSB	most significant bit
MSD	most significant digit
MTBF	mean time between failures
MTTR	mean time to repair
mV	millivolt(s)
mv	multivibrator
MΩ	megohm(s)
n	nano (10^{-9})
na	not applicable
NC	normally closed
(-) or neg	negative
NO	normally open
ns	nanosecond
opnl ampl	operational amplifier
p	pico (10^{-12})
para	paragraph
pcb	printed circuit board
pF	picofarad
pn	part number
(+) or pos	positive
pot	potentiometer
p-p	peak-to-peak
ppm	parts per million
PROM	programmablle read-only memory
psi	pound-force per square inch
RAM	random-access memory
rf	radio frequency
rms	root mean square
ROM	read-only memory
s or sec	second (time)
scope	oscilloscope
SH	shield
SI	silicon
serno	serial number
sr	shift register
Ta	tantalum
tb	terminal board
tc	temperature coefficient or temperature compensating
tcxo	temperature compensated crystal oscillator
tp	test point
u or μ	micro (10^{-6})
uhf	ultra high frequency
us or μs	microsecond(s) (10^{-6})
uut	unit under test
V	volt
v	voltage
var	variable
vco	voltage controlled oscillator
vhf	very high frequency
vlf	very low frequency
W	watt(s)
ww	wire wound
xfmr	transformer
xstr	transistor
xtal	crystal
xtlo	crystal oscillator
Ω	ohm(s)
μ	micro (10^{-6})

Federal Supply Codes for Manufacturers

00213
Nytronics Comp. Group Inc
Subsidiary of Nytronics Inc.
Formerly Sage Electronics
Rochester, New York

00327
Welwyn International, Inc.
Westlake, Ohio

00656
Aerovox Corp.
New Bedford, Massachusetts

00686
Film Capacitors, Inc.
Passaic, New Jersey

00779
AMP Inc.
Harrisburg, Pennsylvania

01121
Allen-Bradley Co.
Milwaukee, Wisconsin

01281
TRW Electronic Comp.
Semiconductor Operations
Lawndale, California

01295
Texas Instruments, Inc.
Semiconductor Group
Dallas, Texas

01537
Motorola Communications &
Electronics Inc.
Franklin Park, Illinois

01686
RCL Electronics Inc.
Manchester, New Hampshire

01730
Replaced by 73586

01884
Use 56289
Sprague Electric Co.
Dearborn Electronic Div.
Lockwood, Florida

02114
Ferroxcube Corp.
Saugerties, New York

02131
General Instrument Corp.
Harris ASW Div.
Westwood, Maine

02395
Rason Mfg. Co.
Brooklyn, New York

02533
Snelgrove, C.R. Co., Ltd.
Don Mills, Ontario, Canada
M3B 1M2

02606
Fenwal Labs
Div. of Travenal Labs.
Morton Grove, Illinois

02660
Bunker Ramo Corp , Conn Div.
Formerly Amphenol-Borg
Electric Corp.
Broadview, Illinois

02799
Areo Capacitors, Inc.
Chatsworth, California

03508
General Electric Co.
Semiconductor Products
Syracuse, New York

03614
Replaced by 71400

03651
Replaced by 44655

03797
Eldema Div.
Genisco Technology Corp.
Compton, California

03877
Transistron Electronic Corp.
Wakefield, Massachusetts

03888
KDI Pyrofilm Corp.
Whippany, New Jersey

03911
Clairex Electronics Div.
Clairex Corp.
Mt. Vernon, New York

03980
Muirhead Inc.
Mountainside, New Jersey

04009
Arrow Hart Inc.
Hartford, Connecticut

04062
Replaced by 72136

04202
Replaced by 81312

04217
Essex International Inc.
Wire & Cable Div
Anaheim, California

04221
Aemco, Div. of
Midtex Inc.
Mankato, Minnesota

04222
AVX Ceramics Div.
AVX Corp.
Myrtle Beach, Florida

04423
Telonic Industries
Laguna Beach, California

04645
Replaced by 75376

04713
Motorola Inc. Semiconductor
Products
Phoenix, Arizona

04946
Standard Wire & Cable
Los Angeles, California

05082
Replaced by 94988

05236
Jonathan Mfg. Co.
Fullerton, California

05245
Components Corp. now
Corcom, Inc
Chicago, Illinois

05277
Westinghouse Electric Corp.
Semiconductor Div.
Youngwood, Pennsylvania

05278
Replaced by 43543

05279
Southwest Machine &
Plastic Co
Glendora, California

05397
Union Carbide Corp.
Materials Systems Div.
New York, New York

05571
Use 56289
Sprague Electric Co.
Pacific Div
Los Angeles, California

05574
Viking Industries
Chatsworth, California

05704
Replaced by 16258

05820
Wakefield Engineering Inc.
Wakefield, Massachusetts

06001
General Electric Co.
Electronic Capacitor &
Battery Products Dept.
Columbia, South Carolina

06136
Replaced by 63743

06383
Panduit Corp.
Tinley Park, Illinois

06473
Bunker Ramo Corp.
Amphenol SAMS Div.
Chatsworth, California

06555
Beede Electrical Instrument Co.
Penacook, New Hampshire

06739
Electron Corp
Littleton, Colorado

06743
Clevite Corp
Cleveland, Ohio

06751
Components, Inc. Semcor Div.
Phoenix, Arizona

06860
Gould Automotive Div.
City of Industry, California

06961
Vernitron Corp., Piezo
Electric Div
Formerly Clevite Corp., Piezo
Electric Div.
Bedford, Ohio

06980
Eimac Div
Varian Associates
San Carlos, California

07047
The Ross Milton Co
South Hampton, Pennsylvania

07115
Replaced by 14674

07138
Westinghouse Electric Corp.,
Electronic Tube Div
Horsehead, New York

07233
TRW Electronic Components
Cinch Graphic
City of Industry, California

07256
Silicon Transistor Corp
Div. of BBF Group Inc.
Chelmsford, Massachusetts

07261
Aumet Corp.
Culver City, California

07263
Fairchild Semiconductor
Div. of Fairchild Camera
& Instrument Corp.
Mountain View, California

07344
Bircher Co., Inc.
Rochester, New York

07597
Burndy Corp.
Tape/Cable Div.
Rochester, New York

07792
Lerma Engineering Corp.
Northampton, Massachusetts

07910
Teledyne Semiconductor
Formerly Continental Device
Hawthorne, California

07933
Use 49956
Raytheon Co
Semiconductor Div. HQ
Mountain View, California

08225
Industro Transistor Corp
Long Island City, New York

Federal Supply Codes for Manufacturers (cont)

08261
Spectra Strip Corp
Garden Grove, California

08530
Reliance Mica Corp
Brooklyn, New York

08806
General Electric Co
Miniature Lamp Products Dept
Cleveland, Ohio

08863
Nylomatic Corp
Norrisville, Pennsylvania

08988
Use 53085
Skottie Electronics Inc.
Archbald, Pennsylvania

09214
G.E. Co Semi-Conductor
Products Dept
Power Semi-Conductor
Products OPN Sec
Auburn, New York

09353
C and K Components
Watertown, Massachusetts

09423
Scientific Components, Inc.
Santa Barbara, California

09922
Burndy Corp.
Norwalk, Connecticut

09969
Dale Electronics Inc
Yankton, S. Dakota

10059
Barker Engineering Corp.
Formerly Amerace, Amerace
ESNA Corp.
Kenilworth, New Jersey

11236
CTS of Berne
Berne, Indiana

11237
CTS Keene Inc.
Paso Robles, California

11358
CBS Electronic Div
Columbia Broadcasting System
Newburyport, Minnesota

11403
Best Products Co.
Chicago, Illinois

11503
Keystone Columbia Inc
Warren, Michigan

11532
Teledyne Relays
Hawthorne, California

11711
General Instrument Corp
Rectifier Division
Hicksville, New York

11726
Qualidyne Corp
Santa Clara, California

12014
Chicago Rivet & Machine Co
Bellwood, Illinois

12040
National Semiconductor Corp.
Danburry, Connecticut

12060
Diodes, Inc.
Chatsworth, California

12136
Philadelphia Handle Co.
Camden, New Jersey

12300
Potter-Brumfield Div
AMF Canada LTD
Guelph, Ontario, Canada

12323
Presin Co , Inc.
Shelton, Connecticut

12327
Freeway Corp. formerly
Freeway Washer & Stamping Co
Cleveland, Ohio

12443
The Budd Co. Polychem Products
Plastic Products Div
Bridgeport, Pennsylvania

12615
U.S. Terminals Inc
Cincinnati, Ohio

12617
Hamlin Inc
Lake Mills, Wisconsin

12697
Clarostat Mfg Co
Dover, New Hampshire

12749
James Electronics
Chicago, Illinois

12856
Micrometals
Sierra Madre, California

12954
Dickson Electronics Corp.
Scottsdale, Arizona

12969
Unitrode Corp
Watertown, Massachusetts

13103
Thermalloy Co., Inc
Dallas, Texas

13327
Solitron Devices Inc.
Tappan, New York

13511
Amphenol Cadre Div.
Bunker-Ramo Corp
Los Gatos, California

13606
Use 56289
Sprague Electric Co
Transistor Div
Concord, New Hampshire

13839
Replaced by 23732

14099
Semtech Corp.
Newbury Park, California

14140
Edison Electronic Div
Mc Gray-Edison Co.
Manchester, New Hampshire

14193
Cal-R-Inc formerly
California Resistor, Corp
Santa Monica, California

14298
American Components, Inc
an Insilco Co.
Conshohocken, Pennsylvania

14655
Cornell-Dublier Electronics
Division of Federal Pacific
Electric Co Govt Control Dept.
Newark, New Jersey

14752
Electro Cube Inc
San Gabriel, California

14869
Replaced by 96853

14936
General Instrument Corp
Semi Conductor Products Group
Hicksville, New York

15636
Elec-Trol Inc
Saugus, California

15801
Fenwal Electronics Inc
Div. of Kidde Walter and Co , Inc
Framingham, Massachusetts

15818
Teledyne Semiconductors,
formerly Amelco Semiconductor
Mountain View, California

15849
Litton Systems Inc. Useco Div
formerly Useco Inc
Van Nuys, California

15898
International Business
Machines Corp
Essex Junction, Vermont

15909
Replaced by 14140

16258
Space-Lok Inc
Burbank, California

16299
Corning Glass
Electronic Components Div
Raleigh, North Carolina

16332
Replaced by 28478

16473
Cambridge Scientific Ind.
Div. of Chemed Corporation
Cambridge, Maryland

16742
Paramount Plastics
Fabricators, Inc
Downey, California

16758
Delco Electronics
Div. of General Motors Corp.
Kokomo, Indiana

17001
Replaced by 71468

17069
Circuit Structures Lab.
Burbank, California

17338
High Pressure Eng Co., Inc.
Oklahoma City, Oklahoma

17545
Atlantic Semiconductors, Inc
Asbury Park, New Jersey

17856
Siliconix, Inc
Santa Clara, California

17870
Replaced by 14140

18178
Vactec Inc.
Maryland Heights, Missouri

18324
Signetics Corp
Sunnyvale, California

18612
Vishay Resistor Products Div
Vishay Intertechnology Inc
Malvern, Pennsylvania

18736
Voltronics Corp.
Hanover, New Jersey

18927
GTE Sylvania Inc
Precision Material Group
Parts Division
Titusville, Pennsylvania

19451
Perine Machinery & Supply Co
Seattle, Washington

19701
Electro-Midland Corp
Mepco-Electra Inc
Mineral Wells, Texas

20584
Enochs Mfg Inc
Indianapolis, Indiana

Federal Supply Codes for Manufacturers (cont)

20891
Self-Organizing Systems, Inc.
Dallas, Texas

21604
Bucheye Stamping Co.
Columbus, Ohio

21845
Solitron Devices Inc.
Transistor Division
Riveria Beach, Florida

22767
ITT Semiconductors
Palo Alto, California

23050
Product Comp. Corp.
Mount Vernon, New York

23732
Tracor Inc.
Rockville, Maryland

23880
Stanford Applied Engrng.
Santa Clara, California

23936
Pamotor Div., Wm J. Purdy Co.
Burlingame, California

24248
Replaced by 94222

24355
Analog Devices Inc.
Norwood, Massachusetts

24655
General Radio
Concord, Massachusetts

24759
Lenox-Fugle Electronics Inc.
South Plainfield, New Jersey

25088
Siemen Corp
Isilen, New Jersey

25403
Amperex Electronic Corp
Semiconductor &
Micro-Circuits Div
Slatersville, Rhode Island

27014
National Semiconductor Corp.
Santa Clara, California

27264
Molex Products
Downers Grove, Illinois

28213
Minnesota Mining & Mfg. Co.
Consumer Products Div
St Paul, Minnesota

28425
Serv-/-Link formerly
Bohannan Industries
Fort Worth, Texas

28478
Deltrol Controls Div
Deltrol Corporation
Milwaukee, Wisconsin

28480
Hewlett Packard Co.
Corporate HQ
Palo Alto, California

28520
Heyman Mfg. Co.
Kenilworth, New Jersey

29083
Monsanto, Co., Inc.
Santa Clara, California

29604
Stackpole Components Co.
Raleigh, North Carolina

30148
AB Enterprise Inc.
Ahoskie, North Carolina

30323
Illinois Tool Works, Inc.
Chicago, Illinois

31091
Optimax Inc.
Colmar, Pennsylvania

32539
Mura Corp.
Great Neck, New York

32767
Griffith Plastic Corp.
Burlingame, California

32879
Advanced Mechanical
Components
Northridge, California

32897
Erie Technological Products, Inc.
Frequency Control Div
Carlisle, Pennsylvania

32997
Bourns Inc.
Trimpot Products Division
Riverside, California

33173
General Electric Co.
Products Dept.
Owensboro, Kentucky

34333
Silicon General
Westminister, California

34335
Advanced Micro Devices
Sunnyvale, California

34802
Electromotive Inc.
Kenilworth, New Jersey

37942
P.R. Mallory & Co., Inc
Indianapolis, Indiana

42498
National Radio
Melrose, Massachusetts

43543
Nytronics Inc.
Transformer Co. Div.
Geneva, New York

44655
Ohmite Mfg Co.
Skokie, Illinois

49671
RCA Corp.
New York, New York

49956
Raytheon Company
Lexington, Massachusetts

50088
Mostek Corp.
Carrollton, Texas

50579
Litronix Inc
Cupertino, California

51605
Scientific Components Inc.
Linden, New Jersey

53021
Sangamo Electric Co.
Springfield, Illinois

54294
Cutler-Hammer Inc. formerly
Shallcross, A Cutter-Hammer Co.
Selma, North Carolina

55026
Simpson Electric Co.
Div. of Am. Gage and Mach. Co.
Elgin, Illinois

56289
Sprague Electric Co.
North Adams, Massachusetts

58474
Superior Electric Co.
Bristol, Connecticut

60399
Torin Corp. formerly
Torrington Mfg. Co.
Torrington, Connecticut

63743
Ward Leonard Electric Co., Inc.
Mount Vernon, New York

64834
West Mfg. Co.
San Francisco, California

65092
Weston Instruments Inc.
Newark, New Jersey

66150
Winslow Tele-Tronics Inc.
Eaton Town, New Jersey

70485
Atlantic India Rubber Works
Chicago, Illinois

70563
Amperite Company
Union City, New Jersey

70903
Belden Corp.
Geneva, Illinois

71002
Birnback Radio Co., Inc.
Freeport, New York

71400
Bussmann Mfg.
Div. of McGraw-Edison Co.
Saint Louis, Missouri

71450
CTS Corp
Elkhart, Indiana

71468
ITT Cannon Electric Inc.
Santa Ana, California

71482
Clare, C.P. & Co
Chicago, Illinois

71590
Centrelab Electronics
Div. of Globe Union Inc.
Milwaukee, Wisconsin

71707
Coto Coil Co., Inc.
Providence, Rhode Island

71744
Chicago Miniature Lamp Works
Chicago, Illinois

71785
TRW Electronics Components
Cinch Connector Operations Div.
Elk Grove Village
Chicago, Illinois

72005
Wilber B. Driver Co.
Newark, New Jersey

72092
Replaced by 06980

72136
Electro Motive Mfg. Co.
Williamantic, Connecticut

72259
Nytronics Inc.
Pelham Manor, New Jersey

72619
Dialight Div.
Amperex Electronic Corp.
Brooklyn, New York

72653
G.C. Electronics
Div. of Hydrometals, Inc
Brooklyn, New York

72665
Replaced by 90303

72794
Dzus Fastener Co., Inc.
West Islip, New York

72928
Gulton Ind. Inc.
Gudeman Div
Chicago, Illinois

Federal Supply Codes for Manufacturers (cont)

72982
Erie Tech. Products Inc.
Erie, Pennsylvania

73138
Bechman Instrument Inc.
Helipot Division
Fullerton, California

73293
Hughes Aircraft Co.
Electron Dynamics Div.
Torrance, California

73445
Amperex Electronic Corp.
Hicksville, New York

73559
Carling Electric Inc.
West Hartford, Connecticut

73586
Circle F Industries
Trenton, New Jersey

73734
Federal Screw Products, Inc.
Chicago, Illinois

73743
Fischer Special Mfg. Co.
Cincinnati, Ohio

73899
JFD Electronics Co.
Components Corp.
Brooklyn, New York

73949
Guardian Electric Mfg. Co.
Chicago, Illinois

74199
Quan Nichols Co.
Chicago, Illinois

74217
Radio Switch Corp.
Marlboro, New Jersey

74276
Signalite Div.
General Instrument Corp.
Neptune, New Jersey

74306
Piezo Crystal Co.
Carlisle, Pennsylvania

74542
Hoyt Elect. Instr. Works
Penacook, New Hampshire

74970
Johnson E.F., Co.
Waseca, Minnesota

75042
TRW Electronics Components
IRC Fixed Resistors
Philadelphia, Pennsylvania

75376
Kurz-Kasch Inc.
Dayton, Ohio

75378
CTS Knights Inc.
Sandwich, Illinois

75382
Kulka Electric Corp.
Mount Vernon, New York

75915
Littlefuse Inc.
Des Plaines, Illinois

76854
Oak Industries Inc.
Switch Div.
Crystal Lake, Illinois

77342
AMF Inc.
Potter & Brumfield Div.
Princeton, Indiana

77638
General Instrument Corp.
Rectifier Division
Brooklyn, New York

77969
Rubbercraft Corp. of CA. LTD.
Torrance, California

78189
Shakeproof
Div. of Illinois Tool Works Inc.
Elgin, Illinois

78277
Sigma Instruments, Inc.
South Braintree, Massachusetts

78488
Stackpole Carbon Co.
Saint Marys, Pennsylvania

78553
Eaton Corp. Engineered
Fastener Div.
Tinnerman Plant
Cleveland, Ohio

79136
Waldes Kohinoor Inc.
Long Island City, New York

79497
Western Rubber Company
Goshen, Indiana

79963
Zierick Mfg. Corp.
Mt. Kisko, New York

80031
Electro-Midland Corp.
Mepco Div.
A North American Phillips Co.
Norristown, New Jersey

80145
LFE Corp., Process Control Div.
formerly API Instrument Co.
Chesterland, Ohio

80183
Use 56289
Sprague Products
North Adams, Massachusetts

80294
Bourns Inc., Instrument Div.
Riverside, California

80583
Hammarlund Mfg. Co., Inc.
Red Bank, New Jersey

80640
Arnold Stevens, Inc.
South Boston, Massachusetts

81073
Grayhill, Inc.
La Grange, Illinois

81312
Winchester Electronics
Div. of Litton Industries Inc.
Oakville, Connecticut

81483
Therm-O-Disc Inc.
Mansfield, Ohio

81483
International Rectifier Corp.
Los Angeles, California

81590
Korry Mfg. Co.
Seattle, Washington

81741
Chicago Lock Co.
Chicago, Illinois

82305
Palmer Electronics Corp.
South Gate, California

82389
Switchcraft Inc.
Chicago, Illinois

82415
North American Phillips
Controls Corp
Frederick, Maryland

82872
Roanwell Corp.
New York, New York

82877
Rotron Inc.
Woodstock, New York

82879
ITT Royal Electric Div.
Pawtucket, Rhode Island

83003
Varo Inc.
Garland, Texas

83058
The Carr Co., United Can Div.
of TRW
Cambridge, Massachusetts

83298
Bendix Corp.
Electric Power Div.
Eatontown, New Jersey

83330
Herman H. Smith, Inc.
Brooklyn, New York

83478
Rubbercraft Corp.
of America, Inc.
West Haven, Connecticut

83594
Burroughs Corp.
Electronic Components Div.
Plainfield, New Jersey

83740
Union Carbide Corp.
Battery Products Div.
formerly Consumer Products Div.
New York, New York

84171
Arco Electronics
Great Neck, New York

84411
TRW Electronic Components
TRW Capacitors
Ogallala, Nebraska

84613
Fuse Indicator Corp.
Rockville, Maryland

84682
Essex International Inc
Industrial Wire Div.
Peabody, Massachusetts

86577
Precision Metal Products
of Malden Inc.
Stoneham, Massachusetts

86684
Radio Corp. of America
Electronic Components Div.
Harrison, New Jersey

86928
Seastrom Mfg. Co., Inc.
Glendale, California

87034
Illuminated Products Inc.
Subsidiary of Oak Industries Inc.
Anahiem, California

88219
Gould Inc.
Industrial Div
Trenton, New Jersey

88245
Litton Systems Inc.
Useco Div.
Van Nuys, California

88419
Cornell-Dubilier Electronic Div.
Federal Pacific Co.
Fuquay-Varian, North Carolina

88486
Plastic Wire & Cable
Jewitt City, Connecticut

88690
Replaced by 04217

89536
John Fluke Mfg. Co., Inc.
Seattle, Washington

89730
G.E. Co., Newark Lamp Works
Newark, New Jersey

Federal Supply Codes for Manufacturers (cont)

90201
Mallory Capacitor Co.
Div. of P.R. Mallory Co., Inc.
Indianapolis, Indiana

90211
Use 56365
Square D Co.
Chicago, Illinois

90215
Best Stamp & Mfg. Co.
Kansas City, Missouri

90303
Mallory Battery Co.
Div. of Mallory Co., Inc.
Tarrytown, New York

91094
Essex International Inc.
Suglex/IWP Div.
Newmarket, New Hampshire

91293
Johanson Mfg. Co.
Boonton, New Jersey

91407
Replaced by 58474

91502
Associated Machine
Santa Clara, California

91506
Augat Inc.
Attleboro, Massachusetts

91637
Dale Electronics Inc.
Columbus, Nebraska

91662
Elco Corp.
Willow Grove, Pennsylvania

91737
Use 71468
Gremar Mfg. Co., Inc.
ITT Cannon/Gremar
Santa Ana, California

91802
Industrial Devices, Inc.
Edgewater, New Jersey

91833
Keystone Electronics Corp.
New York, New York

91836
King's Electronics Co., Inc.
Tuckahoe, New York

91929
Honeywell Inc.
Micro Switch Div.
Freeport, Illinois

91934
Miller Electric Co., Inc.
Div. of Aunet
Woonsocket, Rhode Island

92194
Alpha Wire Corp.
Elizabeth, New Jersey

93332
Sylvania Electric Products
Semiconductor Products Div.
Woburn, Massachusetts

94145
Replaced by 49956

94154
Use 94988
Wagner Electric Corp.
Tung-Sol Div.
Newark, New Jersey

94222
Southco Inc. formerly
South Chester Corp.
Lester, Pennsylvania

95146
Alco Electronic Products Inc.
Lawrence, Massachusetts

95263
Leecraft Mfg. Co.
Long Island City, New York

95264
Replaced by 98278

95275
Vitramon Inc.
Bridgeport, Connecticut

95303
RCA Corp.
Receiving Tube Div.
Cincinnati, Ohio

95348
Gordo's Corp.
Bloomfield, New Jersey

95354
Methode Mfg. Corp.
Rolling Meadows, Illinois

95712
Bendix Corp.
Electrical Components Div.
Microwave Devices Plant
Franklin, Indiana

95987
Weckesser Co. Inc.
Chicago, Illinois

96733
San Fernando Electric Mfg. Co.
San Fernando, California

96853
Gulton Industries Inc.
Measurement and Controls Div.
formerly Rustrak Instruments Co.
Manchester, New Hampshire

96881
Thomson Industries, Inc.
Manhasset, New York

97540
Master Mobile Mounts, Div. of
Whitehall Electronics Corp.
Ft. Meyers, Florida

97913
Industrial Electronic
Hardware Corp.
New York, New York

97945
Penwalt Corp.
SS White Industrial Products Div.
Piscataway, New Jersey

97966
Replaced by 11358

98094
Replaced by 49956

98159
Rubber-Teck, Inc.
Gardena, California

98278
Malco A Microdot Co., Inc.
Connector & Cable Div.
Pasadena, California

98291
Sealectro Corp.
Mamaroneck, New York

98388
Royal Industries
Products Div.
San Diego, California

98743
Replaced by 12749

98925
Replaced by 14433

99120
Plastic Capacitors, Inc.
Chicago, Illinois

99217
Bell Industries Elect.
Comp. Div.
formerly Southern Elect. Div.
Burbank, California

99392
STM
Oakland, California

99515
ITT Jennings Monrovia Plant
Div. of ITT Jennings formerly
Marshall Industries Capacitor Div.
Monrovia, California

99779
Use 29587
Bunker-Ramo Corp.
Barnes Div.
Landsdowne, Pennsylvania

99800
American Precision Industries Inc.
Delevan Division
East Aurora, New York

99942
Centrelab Semiconductor
Centrelab Electronics Div. of
Globe-Union Inc.
El Monte, California

Toyo Electronics
(R-Ohm Corp.)
Irvine, California

National Connector
Minneapolis, Minnesota

U.S. SALES AREAS

AK, Anchorage
Harry Lang & Associates
1371 Hillcrest Drive #303
Anchorage, AK 99503
(907) 279-5741

AL, Huntsville
John Fluke Mfg. Co., Inc.
3322 S Memorial Parkway
Suite 96
Huntsville, AL 35801
(205) 881-6220
(404) 396-3224 (Atlanta)

AZ, Tempe
John Fluke Mfg. Co., Inc
2125 S 48th Street
Suite 104
Tempe, AZ 85282
(602) 967-8724
(602) 790-9881 (Tucson)

CA, Los Angeles
John Fluke Mfg. Co , Inc.
20902 South Bonita St.
Carson, CA 90746
(213) 538-3900 or
(714) 761-2449

CA, Santa Clara
John Fluke Mfg Co., Inc
2300 Walsh Ave , Bldg. K
Santa Clara, CA 95051
(408) 727-0513

CA, Tustin
John Fluke Mfg Co , Inc
15445 Red Hill Ave , Suite F
Tustin, CA 92680
(714) 838-8863
(714) 226-1254 (San Diego)

CO, Denver
John Fluke Mfg. Co., Inc
1980 South Quebec St. #4
Denver, CO 80231
(303) 750-1222

CT, Hartford
John Fluke Mfg Co , Inc
124 Hebron Ave
Glastonbury, CT 06033
(203) 633-0777

FL, Orlando
John Fluke Mfg. Co., Inc.
940 N. Fern Creek Ave.
Orlando, FL 32803
(305) 896-4881

GA, Atlanta
(404) 396-3224

HI, Honolulu
EMC Corporation
2979 Ualena St
Honolulu, HI 96819
(808) 836-1138

IA, Iowa City
(319) 354-2811

IL, Chicago
John Fluke Mfg. Co., Inc.
1400 Hicks Road
Rolling Meadows, IL 60008
(312) 398-0850

IN, Indianapolis
John Fluke Mfg. Co., Inc
5610 Crawfordsville Rd.
Corporate Square West
Suite 802
Indianapolis, IN 46224
(317) 244-2456

KA, Kansas City
John Fluke Mfg. Co , Inc.
4550 West 109th St.
Suite 130
Shawnee Mission, KA 66211
(913) 381-9800

LA, New Orleans
(504) 455-0814

MA, Burlington
John Fluke Mfg. Co., Inc.
25 "B" Street
Burlington, MA 01803
(617) 273-4674

MD, Rockville
John Fluke Mfg.Co., Inc.
5640 Fishers Lane
Rockville, MD 20852
(301) 770-1570
(301) 792-7060 (Baltimore)

MI, Detroit
John Fluke Mfg. Co., Inc.
13955 Farmington Rd
Livonia, MI 48154
(313) 522-9140

MN, Minneapolis
John Fluke Mfg. Co., Inc
7373 West 147th St.
Suite 196
Apple Valley, MN 55124
(612) 432-9400

MO, St. Louis
John Fluke Mfg. Co., Inc.
300 Brookes Dr., Suite 100
Hazelwood, MO 63042
(314) 731-3388

NC, Greensboro
John Fluke Mfg. Co., Inc.
1310 Beaman Place
Greensboro, NC 27408
(919) 273-1918

NJ, Paramus
John Fluke Mfg. Co., Inc.
P.O. Box 930
West 75 Century Road
Paramus, NJ 07652
(201) 262-9550

NM, Albuquerque
John Fluke Mfg. Co., Inc.
1108 Alvarado Drive N.E
Albuquerque, NM 87110
(505) 265-8431

NY, Rochester
John Fluke Mfg. Co., Inc.
4515 Culver Road
Rochester, NY 14622
(716) 266-1400

OH, Cleveland
John Fluke Mfg. Co., Inc.
7830 Freeway Circle
Middleburg Heights, OH 44130
(216) 234-4540

OH, Dayton
John Fluke Mfg. Co., Inc.
4756 Fishburg Rd.
Dayton, OH 45424
(513) 233-2238
(614) 889-5715 (Columbus)

OR, Portland
John Fluke Mfg. Co., Inc.
18360 S.W. Springfield Lane
Aloha, OR 97007
(503) 642-1342

PA, Philadelphia
John Fluke Mfg. Co., Inc.
1010 West 8th Ave., Suite H
King of Prussia, PA 19406
(215) 265-4040
(412) 261-5171 (Pittsburgh)

TX, Austin
John Fluke Mfg. Co., Inc.
Creek Gardens, Suite 103
8705 Shoal Creek Blvd.
Austin, TX 78758
(512) 459-3344

TX, Dallas
John Fluke Mfg. Co., Inc.
14400 Midway Road
Dallas, TX 75234
(214) 233-9990

TX, Houston
John Fluke Mfg. Co., Inc.
4240 Blue Bonnet Dr.
Stafford, TX 77477
(713) 491-5995
(504) 455-0814 (New Orleans)

UT, Salt Lake City
John Fluke Mfg. Co., Inc.
5226 So. 300 West, Suite #2
Salt Lake City, UT 84107
(801) 268-9331

WA, Seattle
John Fluke Mfg Co., Inc.
975 Industry Drive
Seattle, WA 98188
(206) 575-3765

For more information on Fluke products or Sales Offices you may dial (800) 426-0361 toll-free in most of U.S.
From Alaska, Hawaii, or Washington phone (206) 356-5400. From other countries phone (206) 356-5500.

John Fluke Mfg. Co., Inc., P.O. Box C9090, Everett, WA 98206. Phone (206) 342-6300
Fluke (Holland) B.V., P.O. Box 5053, 5004 EB, Tilburg, The Netherlands. Phone (013) 673973
Litho in U.S.A. 12/81

FLUKE®

INTERNATIONAL SALES OFFICES

Argentina ●
Coasin, S A
Virrey del Pino 4071
Buenos Aires, Argentina
Tel: 5523185, TLX: 390122284

Australia ●
Elmeasco Instruments Pty Ltd
P O Box 30, Concord, N.S.W.
Australia 2137
Tel: (2) 736-2888, TLX: AA25887

Elmeasco Instruments Pty Ltd
P O Box 107
Mt Waverly, VIC. 3149
Australia
Tel: 233-4044
TLX: 36206 (ELMVIC)

Elmeasco Instruments Pty Ltd
Professional Suite's Bldg.
G P O Box 2360
Brisbane, 4001, Australia
Tel: (07) 229-3161

Elmeasco Instruments Pty Ltd
P O Box 1240
G P O Adelaide 5001
South Australia

Elmeasco Instruments Pty Ltd.
P.O Box 95, Gosnells
West Australia 6110
Tel: (09) 348-3362

Austria ■
Walter Rekirsch
Elektronische Gerate GmbH & Co.
Vertrieb-KG., Obachgasse 28
A-1220 Vienna, Austria
Tel: (0222) 235555, TLX: 134759

Bahrain ■
AL-Hamidiya
P O. Box 20074
Manama, Bahrain
Tel: 259958, TLX: 8895

Bangladesh ●
Motherland Corporation
24 Hatkhola Rd , Tikatuli
Dacca 3, Bangladesh
Tel: 257249, 255776

Belgium ■
Fluke (Belgium) S A./N.V.
6, Rue de Geneve
1140 Brussels, Belgium
Tel: (2) 2164090, TLX: 26312

Bolivia ●
Coasin Bolivia S.R.L.
Casilla 7295, La Paz, Bolivia
Tel: 40962, TLX: 5255

Brazil ●
Fluke Brasil-Industria E
Commercio LTDA
Al Amazonas 422,
Alphaville, Barueri,
CEP 06400 Sao Paulo, Brazil
Tel: (011) 421-3603

Brunei ●
Rank O'Connor's (PTE) Limited
No. 8, BK D
Surfri Shop House Complex
Mile 1, Jalong Tutong
Bandar Seri Begawan, Brunei
Tel: 26680

Bulgaria ■
Amtest Associates Ltd
P O Box 55
Addlestone, Surrey KT15 1DU
United Kingdom
Tel: Weybridge (932) 52121
TLX: 928855

Canada ●
Allan Crawford Assoc., Ltd
#14 1935 30th Ave N E.
Calgary, Alberta T2E 6Z5
Tel: (403) 230-1341, TLX: 03-821186

Allan Crawford Assoc., Ltd
Suite 1, Box 60
Edmonton, Alberta T5L 4H8
Tel: (403) 451-4893

Allan Crawford Assoc , Ltd
3795 William Street
Burnaby, British Columbia V5C 3H3
Tel: (604) 294-1326, TLX: 04-54247

Allan Crawford Assoc., Ltd
192 Joseph Zatzman Dr
Suite 4
Burnside Industrial Park
Dartmouth, Nova Scotia B3B 1N4
Tel: (902) 463-8640, TLX: 01931604

Allan Crawford Assoc., Ltd
881 Lady Ellen Place
Ottawa, Ontario K1Z 5L3
Tel: (613) 722-7682, TLX: 0533600

Allan Crawford Assoc , Ltd
6503 Northam Drive
Mississauga, Ontario L4V 1J5
Tel: (416) 678-1500, TLX: 06968769

Allan Crawford Assoc , Ltd.
7918 cote de Liesse
St Laurent, Quebec H4T 1E7
Tel: (514) 731-8564, TLX: 05824944

Chad ■
Fluke (Holland) B.V.
P O Box 5053, 5004 EB Tilburg
Zevenheuvelenweg 53, 5048 AN Tilburg
The Netherlands
Tel: (013) 673973, TLX: 52237

Chile ●
Intronica Chile Ltda
Manuel Montt 024 - Of D
Casilla 16228, Santiago 9, Chile
Tel: 44940
TLX: No 40301 Cab Publ.,
Attn: Intronica Chile

China, People's Republic of ●
Fluke International Corporation
P O Box C9090
Everett, WA 98206, U S A.
Tel: (206) 356-5511
TLX: 152662 JOHN FLUKE EVT

Colombia ●
Sistemas E Instrumentacion, Ltda
Carrera 13, No 37-43, Of 401
Ap Aereo 29583
Bogota DE, Colombia SA
Tel: 232-45-32, TLX: 45787

Cyprus ■
Chris Radiovision Ltd
P.O Box 1989, Nicosia, Cyprus
Tel: 66121, TLX: 3495

Czechoslovakia ■
Amtest Associates Ltd
P O. Box 55
Addlestone, Surrey KT15 1DU
United Kingdom
Tel: Weybridge (932) 52121
TLX: 928855

Denmark ■
Tage Olsen A/S
Ballerup Byvej 222
DK - 2750 Ballerup, Denmark
Tel: (2) 658111, TLX: 35293

Ecuador ●
Proteco Coasin Cia , Ltda
Edificio "Jerico"
Ave. 12 de Octubre #2285 y
Ave Orellana (Planta Baja)
Quito, Ecuador
Tel: 529684, TLX: 2865 Protec Ed

Proteco Coasin Cia., Ltda
Calderon 103Y Malecon
Casilla #9733
Guayaquil, Ecuador
Tel: 526093

Egypt and Sudan ■
Electronic Engineering Liaison Office
P O. Box 2891 Horreya
11 Ahmed Khashara St.
Hegas Square
Heliopolis, Cairo, Egypt
Tel: 691588, TLX: 92502

Ethiopia ■
Fluke (Holland) B V.
P O. Box 5053, 5004 EB Tilburg
Zevenheuvelenweg 53, 5048 AN Tilburg
The Netherlands
Tel: (013) 673973, TLX: 52237

Fiji ●
AWA Fiji
P.O Box 858
47 Forster Road, Walu Bay
Suva, Fiji
Tel: 312079, TLX: FJ2347

Finland ■
Oy Findip AB, Teollisuustie 7
02700 Kauniainen, Finland
Puh: (0) 5052255
TLX: 123129

France ■
M B Electronique S A.
Rue Fourny 606, Z1 Centre
78530 BUC
B P No 31
78530 BUC, France
Tel: (3) 9568131, TLX: 695414

German Democratic Republic ■
Amtest Associates Ltd
P.O. Box 55
Addlestone, Surrey KT15 1DU
United Kingdom
Tel: Weybridge (932) 52121
TLX: 928855

German Federal Republic ■
Fluke (Deutschland) GmbH
Max-Hueber StraBe 8
8045 Ismaning, West Germany
Tel: (089) 96251, TLX: 522472
Rapifax: (089) 966718

Fluke (Deutschland) GmbH
Meineckestrasse 53
4000 Dusseldorf 30, West Germany
Tel: (0211) 450831, TLX: 8585576

Fluke (Deutschland) GmbH
Oberer Kirchhaldenweg 135
7000 Stuttgart 1, West Germany
Tel: (0711) 694091, TLX: 722518

Fluke (Deutschland) GmbH
Hubertusallee 46
1000 Berlin-33, West Germany
Tel: (030) 8911090
TLX: 0184978

Greece ■
Hellenic Scientific Representations Ltd
11, Vrasside Street
Athens 612, Greece
Tel: (1) 711140, TLX: 219330

Hong Kong ●
Schmidt & Co (H K.) Ltd.
28th F1 Wing on Centre
111 Connaught Road
Central Hong Kong
Tel: 5-455644
TLX: 74766 SCHMC HX

Hungary ■
Amtest Associates Ltd.
P O Box 55
Addlestone, Surrey KT15 1DU
United Kingdom
Tel: Weybridge (932) 52121
TLX: 928855

Iceland ●
Kristjan O Skagfjord Ltd.
P.O. Box 906
Reykjavik, Iceland
Tel: 24120, TLX: 2133

India ●
Hinditron Services Pvt Ltd.
69/A.L. Jagmohandas Marg
Bombay 400 006, India
Tel: 811316,
TLX: 112326 Hspl In

Hinditron Services Pvt Ltd
33/44-A 8th Main Road
Raj Mahl Vilas Extension
Bangalore 560 080, India
Tel: 33139
TLX: 0845741

Hinditron Services Pvt Ltd
Shantiniketan, Office No.6
6th Floor, 8 Camac Street
Calcutta 700 017, India
Tel: 434032, 447541

Hinditron Services Pvt. Ltd.
15 Community Centre, Panchshila Park
New Delhi 110 017, India
Tel: 653397

Hinditron Services Pvt Ltd
Srinath Complex, 5th Floor
1-1-58/1 to 1-1-58/11
Sarojini Devi Road
Secunderabad 500 003, India
Tel: 61705

Indonesia ●
P T Dwi Tunggal Jaya Sakti
Sangga Buana Bldg , 1st Floor
Jl Senen Raya 44, P O Box 4435
Jakarta, Indonesia
Tel: 367390-9, TLX: 46624

Iran ■
Fluke (Holland) B.V
P O Box 5053, 5004 EB Tilburg
Zevenheuvelenweg 53, 5048 AN Tilburg
The Netherlands
Tel: (013) 673973, TLX: 52237

Iraq ■
Fluke (Holland) B.V
P O Box 5053, 5004 EB Tilburg
Zevenheuvelenweg 53, 5048 AN Tilburg
The Netherlands
Tel: (013) 673973, TLX: 52237

Ireland ■
Euro Electronics
32 Brews Hill
Naven County Meath, Ireland
Tel: (46) 23577, TLX: 3182

Israel ■
R.D.T Electronics Engineering Ltd
P O Box 75
46, Sokolov Street
Ramat Hasharon 47235, Israel
Tel: (3) 483216, TLX: 32143

FLUKE®

John Fluke Mfg. Co., Inc., P.O. Box C9090, Everett, WA 98206. Phone (206) 342-6300
Fluke (Holland) B.V., P.O. Box 5053, 5004 EB, Tilburg, The Netherlands. Phone (013) 673973

Litho in U.S.A. 12/81

Italy ¤
Sistrel S.p A
Via Giuseppe Armellini No 37
00143 Rome, Italy
Tel: (6) 5915551, TLX: 68356

Sistrel S.p A
Via Pelizza da Volpedo 59
20092 Cinisello besamo
Milan, Italy
Tel: (2) 6181893, TLX: 334643

Sistrel S p A
Via Cintia Parco S Paolo 35
80126 Naples, Italy
Tel: (81) 7679700

Japan ●
John Fluke Mfg. Co , Inc
Japan Branch
(PC Board Testers only)
1 Higashikata-machi
Midori-ku
Yokohama 226, Japan
Tel: (045) 473-5425
TLX: 3823-666 FLKJPJ

Tokyo Electron Ltd
38 FL Shinjuko Nomura Bldg.
1-26-2, Nishi-Shinjuku
Shinjuku-ku
Tokyo 160, Japan
Tel: 03-343-4411, TLX: 2322220

Kenya ●
ADCOM Ltd
P.O. Box 30070
Nairobi, Kenya, East Africa
Tel: 331955, TLX: 22639

Korea ●
Electro-Science Korea Co
C P.O Box 8446
Room 201, Boondo Bldg
56-12 Jangchung-IKa
Jung-ku
Seoul, Korea
Tel: 261-7702, TLX: K25381

Kuwait ■
Tareq Company
P O Box Safat 20506
Kuwait, Arabian Gulf
Tel: 436100/436045
TLX: 2315

Lebanon and Jordan ■
Mabek (Electronic Division)
P.O Box 13-5657
Beirut, Lebanon
Tel: 812523/812538
TLX: 22889

Libya ■
Fluke (Holland) B.V
P O. Box 5053, 5004 EB Tilburg
Zevenheuvelenweg 53, 5048 AN Tilburg
The Netherlands
Tel: (013) 673973, TLX: 52237

Malaysia ●
Rank O'Connor's (PTE) Limited
P O Box 91, Petaling Jaya
Selangor, West Malaysia
Tel: 566599
TLX: OCONOR MA37649

Rank O'Connor's (PTE) Limited
Lot No 5 Taman Mesra
Mile 3, Jalan Penampang
Kota Kinabulu, East Malaysia
Tel: 55322, TLX: MA80286

Mexico ●
Christensen S.A.
Guillermo Prieto 76-304
Col San Rafael
Delegacion Cuahutemoc
06470—Mexico, D F
Tel: 546-25-95/546-29-55
TLX: 017-75612

Morocco ■
Mainvest
Residence Moulay Ismail, Bat C.
12, Place des Alaouites
Rabat, Morocco
Tel: (7) 23990, TLX: 31036

Nepal ●
Associated Enterprises
GPO Box 790, Pyaphal Tole
Kathmandu, Nepal
Tel: 13868

Netherlands ■
Fluke (Nederland) B V.
Zonnebaan 39
3606 CH Maarssen, The Netherlands
P O. Box 225
3600 AE Maarssen, The Netherlands
Tel: (030) 436514, TLX: 47128

New Zealand ●
McLean Information Technology
P.O. Box 18-065, Glen Innes
Auckland, New Zealand
Tel: 587-037, TLX: NZ 2763

W & K McLean Ltd
P.O Box 496
Wellington, New Zealand
Tel: 851-450

Nigeria ●
Mofat Engineering Co., Ltd.
P O. Box 6369
Lagos, Nigeria
Tel: 960744, TLX: 20202

Norway ■
Morgenstierne & Co A/S
Konghellegate 3
P O Box 6688, Rodelokka
Oslo 5, Norway
Tel: (2) 356110, TLX: 71719

Pakistan ●
Pak International Operations
505 Muhammadi House
I I Chundrigar Road
P O Box 5323, Karachi, Pakistan
Tel: 221127, TLX: 24494

PDR Yemen ■
Fluke (Holland) B.V
P O Box 5053, 5004 EB Tilburg
Zevenheuvelenweg 53, 5048 AN Tilburg
The Netherlands
Tel: (013) 673973, TLX: 52237

Peru ●
Importaciones Y Representaciones
Electronicas S A
Avda Franklin D. Roosevelt 105
Lima 1, Peru
Tel: 288650, TLX: 37425663

Phillipines ●
Spark Radio & Electric Supply
P O Box 610, Greenhills, San Juan
M Manila, Phillipines
Tel: 78-78-16
TLX: 27901 RLA PH

Poland ■
Amtest Associates Ltd
P O Box 55
Addlestone, Surrey KT15 1DU
United Kingdom
Tel: Weybridge (932) 52121
TLX: 928855

Portugal ■
Decada-Equipamentos de
Electronica, Lda.
Rue Pedro Nunes, 47-C
1000 Lisboa
P.O. Box 1128, 1003 Lisboa Codex
Tel: (19) 574984, TLX: 18469

Qatar ■
Technology Organisation
P O Box 5549, Doha, Qatar
Tel: 321431, TLX: 4581

Romania ■
Amtest Associates Ltd
P O. Box 55
Addlestone, Surrey KT15 1DU
United Kingdom
Tel: Weybridge (932) 52121
TLX: 928855

Saudi Arabia ■
Electronic Equipment Marketing Co. Ltd.
P O. Box 3750
Riyadh, Saudi Arabia
Tel: (1) 4032761, TLX: 201120

Singapore ●
Rank O'Connor's (PTE) Limited
98 Pasir Panjang Road
Singapore 0511
Republic of Singapore
Tel: 637944
TLX: OCONSIN RS21023

Somalia ■
Fluke (Holland) B.V.
P.O. Box 5053, 5004 EB Tilburg
Zevenheuvelenweg 53, 5048 AN Tilburg
The Netherlands
Tel: (013) 673973, TLX: 52237

South Africa ●
Fluke S.A (Pty) Ltd
P.O Box 39797, Bramley 2018
Republic of South Africa
Tel: (011) 786-3170, TLX: 424328

Spain ■
Hispano Electronica S.A
Poligono Industrial Urtinsa
Apartado de Correos 48
Alcorcon (Madrid), Spain
Tel: (1) 6194108
TLX: 22404/42634

Sri Lanka ●
Jay-Es Electronics
160 Poorvarama Mawatha
Colombo 5, Sri Lanka
Tel: 073-2393

Sweden ■
Teleinstrument AB
P.O Box 4490
162 04 Vallingby, Sweden
Tel: (8) 380370, TLX: 11347

Switzerland ■
Traco Electronic AG
Jenatschstrasse 1
8002 Zurich, Switzerland
Tel: (1) 2010711, TLX: 54318

Syria ■
Mabek (Electronic Division)
P O Box 4238
Damascus, Syria

Taiwan ●
Schmidt Scientific Far East Ltd
906, Chia Hsin Bldg
96, Chung Shan N. Rd., Sec 2
Taipei, Taiwan,
Tel: 5817393/5814976
TLX: 11111

Thailand ●
Measuretronix Ltd
1899/10 Ramkamhaeng Rd
Huamark, Bangkok, Thailand
Tel: 3143369, TLX: 81143

Tunesia ■
Selep S.A.R.L.
6, Rue de Sparte
Tunis - 1000 RP, Tunesia
Tel: (1) 248093, TLX: 13030

Turkey ■
Erkman Elektronik Aletler
Ticaret Anonim Sirketi
Necatibey Cad 92/3
Karakoy, Istanbul, Turkey
Tel (1) 5461
TLX: 23353

United Arab Emirates ■
Al-Sanani Ge Trad. Est.
P.O. Box 7187
Abu-Dhabi, United Arab Emirates
Tel: 828428/821370/821371/
TLX: 23966

United Kingdom ■
Fluke (Great Britain) Ltd
Colonial Way
Watford, Herts, WD2 4TT
United Kingdom
Tel: (0923) 40511, TLX: 934583
Rapifax: (0923) 25067

Uruguay ●
Coasin Uruguaya S.R.L.
Cuareim 2196
Casilla de Correos 1400
Correo Central
Montevideo, Uruguay
Tel: 29-31-95, TLX: UY5671

U.S.S.R. ■
Amtest Associates Ltd.
P.O Box 55
Addlestone, Surrey KT15 1DU
United Kingdom
Tel: Weybridge (932) 52121
TLX: 928855

Venezuela ●
Coasin, C.A.
Calle 9 Con Calle 4, Edif. Edinurbi
Piso 3, La Urbina
Apartado De Correos
NR-70 136 Los Ruices
Caracas 1070A, Venezuela
Tel: 38-78-42, TLX: 21027 Emven Ve

Yemen ■
Fluke (Holland) B.V.
P.O Box 5053, 5004 EB Tilburg
Zevenheuvelenweg 53, 5048 AN Tilburg
The Netherlands
Tel: (013) 673973, TLX: 52237

Yugoslavia ■
Amtest Associates Ltd.
P.O Box 55
Addlestone, Surrey KT 15 1DU
United Kingdom
Tel: Weybridge (932) 52121
TLX: 928855

■ Supplied and Supported by —
Fluke (Holland) B.V.
P.O Box 5053, Zevenheuvelenweg 53
5004 EB Tilburg, Netherlands
Tel: (013) 673973, TLX: 52237

● Supplied and Supported by —
Fluke International Corporation
P O Box C9090
Everett, WA 98206 U.S A
Tel: (206) 356-5500
TLX: 152662 JOHN FLUKE EVT

John Fluke Mfg. Co., Inc., P.O. Box C9090, Everett, WA 98206. Phone (206) 342-6300
Fluke (Holland) B.V., P.O. Box 5053, 5004 EB, Tilburg, The Netherlands. Phone (013) 673973
Litho in U.S.A. 12/81

FLUKE®

TECHNICAL SERVICE CENTERS

U.S. & Canada

CA, Burbank
Fluke Technical Center
2020 N Lincoln Street
Burbank, CA 91504
(213) 849-4641

CA, Santa Clara
Fluke Technical Center
2300 Walsh Ave , Bldg. K
Santa Clara, CA 95050
(408) 727-8121

CO, Denver
Fluke Technical Center
1980 S Quebec St., Unit 4
Denver, CO 80231
(303) 750-1228

FL, Orlando
Fluke Technical Center
940 N Fern Creek Avenue
Orlando, FL 32803
(305) 896-2296

IL, Rolling Meadows
Fluke Technical Center
1400 Hicks Road
Rolling Meadows, IL 60008
(312) 398-5800

MA, Burlington
Fluke Technical Center
25 "B" Street
Burlington, MA 01803
(617) 273-4678

MD, Rockville
Fluke Technical Center
5640 Fishers Lane
Rockville, MD 20852
(301) 770-1576

NJ, Paramus
Fluke Technical Center
West 75th Century Road
Paramus, NJ 07652
(201) 262-9550

TX, Dallas
Fluke Technical Center
14400 Midway Road
Dallas, TX 75240
(214) 233-9945

WA, Everett
Fluke Technical Center
6920 Seaway Blvd.
Everett, WA 98206
(206) 356-5560

ALB, Calgary
Allan Crawford Assoc , Ltd
#14 1935 30th Ave. N.E
Calgary, Alberta T2E 6Z5
(403) 230-1341

ONT, Mississauga
Allan Crawford Assoc., Ltd
6503 Northam Drive
Mississauga, Ontario 1 4V IJ2
(416) 678-1500

QUE, Montreal
Allan Crawford Assoc., Ltd
7018 Cote de Liesse
Montreal, Quebec H4T IE7
(514) 731-8564

B.C., Burnaby
Allan Crawford Assoc Ltd
3795 William St
Burnaby, B.C V5C 3H3
(604) 294-1326

Other Areas

Argentina
Coasin S A
Virrey del Pino 4071
Buenos Aires, Argentina
Tel: 522-5248

Australia
Elmeasco Instruments Pty Ltd.
P.O Box 30
Concord, N S W
Australia 2137
Tel: (02) 736-2888

Australia
Elmeasco Instruments Pty Ltd
P O Box 107
Mr. Waverly, VIC 3149
Australia
Tel: (03) 2334044

Australia
Elmeasco Instruments Pty Ltd
GPO Box 2360
Brisbane, Queensland 4001
Australia
Tel: (07) 229-3161

Austria
Walter Rekirsch
Elektronische Gerate GmbH & Co.
Vertriebs-KG., Obachgasse 28
A-1220 Vienna, Austria
Tel: (0222) 235555

Belgium
Fluke (Belgium) S.A./N.V.
6, Rue de Geneve
1140 Brussels, Belgium
Tel: 09-32-2-2164090

Brazil
Fluke Brasil-Industria e Comercio Ltda
Al Amazonas 422, Alphaville, Barueri
CEP 06400 Sao Paulo, Brazil
Tel: (011) 421-3603

Chile
Intronica Chile Ltda
Casilla 16228
Santiago 9, Chile
Tel: 44940

China, Peoples Republic of
Beijing Radio Research Institute
Dianmen East Avenue 89
Beijing, China
Tel: 445612

Colombia
Sistemas E Instrumentacion, Ltda.
Carrera 13, No. 37-43, Of. 401
Ap. Aero 29583
Bogota DE, Colombia S A.
Tel: 232-45-32

Denmark
Tage Olson A/S
Ballerup Byvej 222
DK-2750 Ballerup
Denmark
Tel: 09-45-2-658111

Ecuador
Proteco Coasin Cia., Ltda
Edificia "Jerico"
Ave. 12 de Octubre #2285 y
Ave. Orellana (Planta Baja)
Quito, Ecuador
Tel: 526759

Egypt and Sudan
Electronic Engineering Liaison Office
11 Ahmed Khashaba Street
Hegas Square
Heliopolis, Cairo, Egypt
Tel: 691588

Finland
Oy Findip AB
Teollisuustie 7
02700 Kauniainen
Finland
Tel: 09-358-0-502255

France
M B Electronique S A
Rue Fourny
ZAC de BUC
B P. No. 31
78530 BUC, France
Tel: 09-33-1-9568131

Greece
Hellenic Scientific
Representations Ltd
11, Vrassida Street
Athens 612, Greece
Tel: 09-30-1-711140

Hong Kong
Schmidt & Co (H K.) Ltd
28th Fl. Wing On Centre
111 Connaught Road
Central Hong Kong
Tel: 5-455644

India
Hinditron Services Pvt. Ltd.
Field Service Centre
8th Main Road
33/44-A Raj Mahal Vilas Extn.
Bangalore 560 080, India
Tel: 33139

India
Hinditron Services Pvt. Ltd.
69/A L Jagmohandas Marg
Bombay 400 006, India
Tel: 811316

India
Hinditron Services Pvt Ltd
15, Community Centre
Panchshila Park
New Delhi, India 110-017
Tel: 619118

Israel
R D.T. Electronics Engineering Ltd
P.O Box 75
46, Sokolov Street
Ramat Hasharon 47235
Israel
Tel: 09-972-3-483211

Italy
Sistrel S p.A.
Via Pelizza da Volpedo 59
20092 Cinisello Besamo
Milan, Italy
Tel: (2) 6181893

Italy
Sistrel S.p.A
Via Giuseppe Armellini No. 37
00143 Rome, Italy
Tel: 09-39-6-5915551

Japan
John Fluke Mfg Co., Inc.
Japan Branch
1 Higashikata-machi
Midori-ku
Yokohama 226, Japan
Tel: (045) 473-5428

Korea
Electro-Science Korea Co
C.P.O. Box 8446
Room 201, Boondo Bldg.
56-12, Gangchung-1 Ka
Gung-Ku
Seoul, Korea
Tel: 261-7702

Malaysia
Rank O'Connor's (Malaysia) SDN BHD
P O. Box 91
Petaling Jaya, Selangor
West Malaysia
Tel: 566599

Mexico
Christensen S A.
Guillermo Prieto 76-304
Col. San Rafael
Delegacion Cuahutemoc
06470-Mexico, D.F.
Tel: 546-25-95

Netherlands
Fluke (Nederland) B.V
Zonnebaan 39
3606 CH Maarssen, The Netherlands
P O Box 225
3600 AE Maarssen, The Netherlands
Tel: (030) 436514

New Zealand
McLean Information Technology Ltd
P.O. Box 18065
Glen Innes
Auckland 6, New Zealand
Tel: 587-037

Norway
Morgenstierne & Co. A/S
Konghellegate 3
P.O. Box 6688, Rodelokka
Oslo 5, Norway
Tel: 09-47-2-356110

Pakistan
Pak International Operations
505 Muhammadi House
I I. Chundrigar Road
P O Box 5323
Karachi-2 Pakistan
Tel: 221127/239052

Peru
Importaciones Y Representaciones
Electronicas S A
Avda Franklin D Roosevelt 105
Lima 1, Peru
Tel: 288650

Phillipines
Spark Radio and Electronics Corp
P.O Box 610 Greenhills
Metro Manila, Philippines 3113
Tel: 78-78-16

Portugal
Equipamentos de Laboratorio, Ltda.
P O Box 1128
Lisbon 1000, Portugal
Tel: 09-351-19-574984

Republic of Singapore
Rank O'Connor's (PTE) Ltd.
98 Pasir Panjang Road
Singapore 0511
Republic of Singapore
Tel: 637944

Republic of South Africa
Fluke S.A (Pty) Ltd
P O. Box 39797
Bramley 2018
Republic of South Africa
Tel: (011) 786-3170

Spain
Hispano Electronics S A
Apartado de Correos 48
Alcorcon (Madrid)
Spain
Tel: 09-34-1-6194108

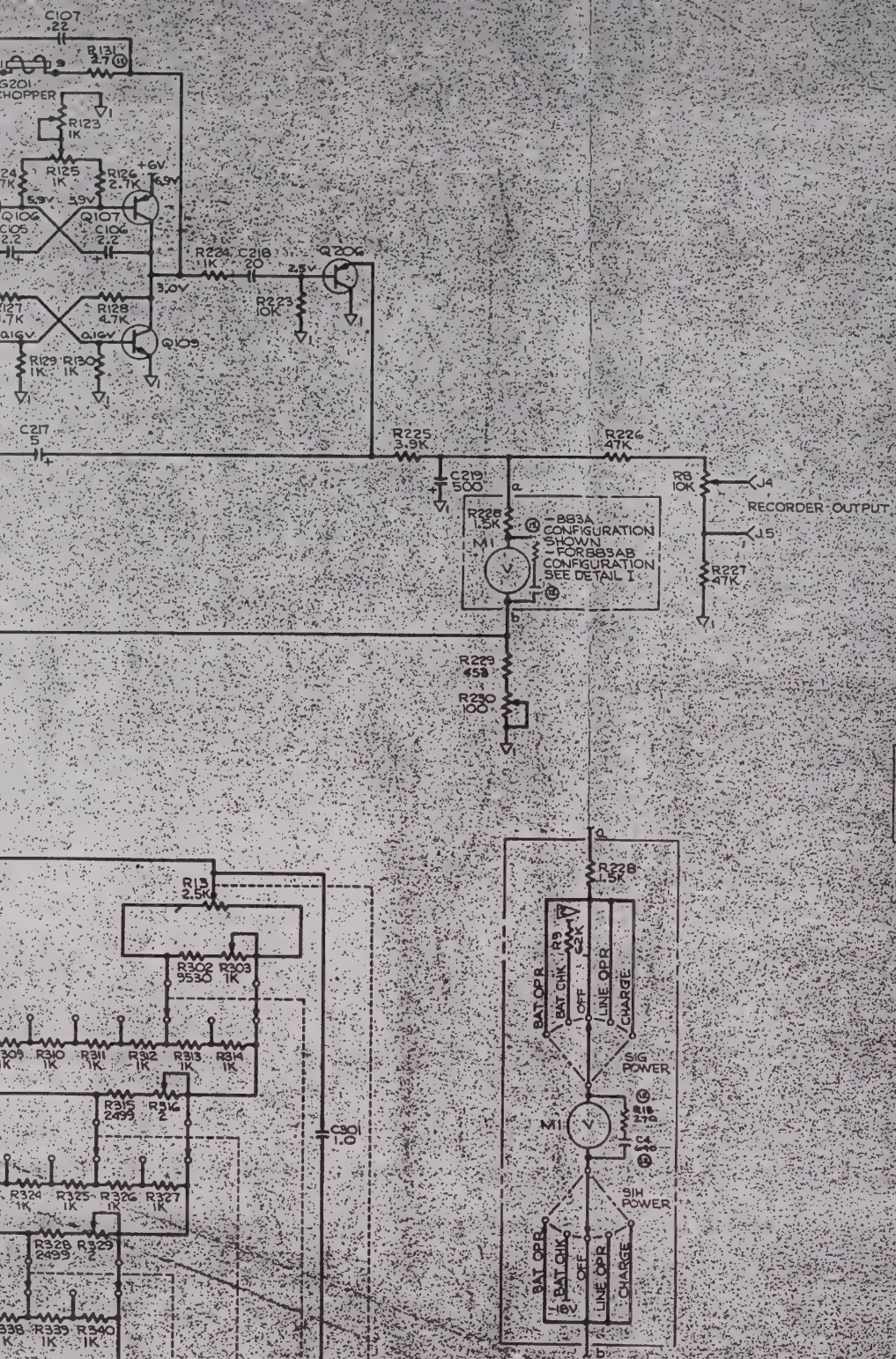
Sweden
Teleinstrument AB
P O Box 4490
S-162 04 Vallingby 4
Sweden
Tel: -09-46-8-380370

Switzerland
Traco Electronic AG
Jenatschstrasse 1
8002 Zurich
Switzerland
Tel: 09-41-1-2010711

FLUKE®

John Fluke Mfg. Co., Inc., P.O. Box C9090, Everett, WA 98206. Phone (206) 342-6300
Fluke (Holland) B.V., P.O. Box 5053, 5004 EB, Tilburg, The Netherlands. Phone (013) 673973

Litho in U.S.A. 12/81



CHANGES

1. FOR SER. NO. 123 TO 127
   R1 (47K) WAS IN SERIES WITH C1
2. FOR SER. NO. 123 TO 147
   R505 NOT USED
3. FOR SER. NO. 123 TO 375
   R529 WAS 5.6K
4. FOR SER. NO. 123 TO 650
   R115 (SELECTED) WAS IN SERIES WITH R116 (650Ω)
5. FOR SER. NO. 123 TO 569
   C401, C403, & C405 WERE 1.0 TO 8.5 pf
   R411 NOT USED
6. FOR SER. NO. 123 TO 589
   C501 WAS 5.1 pf
   C502 WAS 1.0 TO 8.5 pf
7. FOR SER. NO. 751 TO 931, INCLUSIVE
   C3 WAS USED
8. R107 REMOVED AT SER. NO. 920
   R132 ADDED AT SER. NO. 921
9. AT SER. NO. 892
   C402 WAS CHANGED FROM 33 pf TO 15 pf
   C404 WAS CHANGED FROM 390 pf TO 150 pf
   C411 WAS CHANGED FROM 33K TO 82K
10. FOR SER. NO. 1631 AND ON
    C516 CHANGED TO 1500 pf FROM 470 pf
    C509 CHANGED TO 10 pf FROM
    R510 CHANGED TO 33K FROM 56K
    R526 CHANGED TO 150Ω FROM 330Ω
11. FOR SER. NO. 1561 AND ON
    R131 CHANGED TO 2.7Ω FROM 82Ω
12. INSTALLED WITH MINN. HONEYWELL METERS ON
13. FOR SER. NO. 123 THRU 18
    C206 WAS 100 uf
    C206 WAS 70 uf
    C207 WAS 5 uf
    Q207 NOT INSTALLED
    R2
    R206 WAS 1K
    R209 WAS 5K PO

VOLTAGE RANGE	NULL RANGE			
	LO	MED LO	MED HI	HI
1	0.1	0.01	0.001	0.0001
10	1.0	0.1	0.01	
100	10	1.0	0.1	0.01
1000	100	10	1.0	

NOTES:
REFERENCE DESIGNATIONS
BT1-4
C1-4, 101-107, 201-220, 301, 401-403, 501-507
CR1-3, 101, 102, 201, 202, 501, 507
DS201
G201
J1-6
M1
P3-2
Q101-109, 201-207, 501-509
R1-15, 100-115, 117, 132, 201-240, 302, 401-411, 501-545
S1-8
T1
F1

ALL FLAGNOTES WITH THE SAME NUMBER ARE CONNECTED

▽2 INDICATES -18V RETURN

▽1 INDICATES +6V AND -18V RETURN

FUNCTIONAL SCHEMATIC

DIFFERENTIAL VOLTMETER

MODELS 883A and 883AB

883A SER. NO. 123 AND ON
883AB SER. NO. 123 AND ON

JOHN FLUKE MFG. CO., INC.

DETAIL III

DETAIL II

DETAIL IV

SEE DETAIL IV

ADDED TO B83A & B83AB S/N 1931 & ON

INPUT
J1
S4B
AC
S4A
AC
COMMON
J2
C1 .01
CRA9S1S
J3
V2
S2E RANGE
1V
10V
100V
1000V
S2F RANGE
S2CD RANGE
S2AB RANGE
C2 .47
R104 100,0.5K
R103 3.3M
R102 3.3M
R101
R100
C513 2.2
R521 62K
11.9V
R522 100K
11.3V
R519 15K
+18V
Q505
R523 300
3.3V
CR503
CR504
CR504
C517 150
Q506 3.0V
R524 47
R525 470
C514 150
R528 100K
+18V
R529 2.7K
R544 22M
R530 547
R531 541
R527 10K
C516 1600PF
180
R526
C508 68
R515 82
R514 2.7K
R513 2700
Q503 2.7V
Q502
3.5V
R516 68K
C509 10PF
R504 125
C505 30
CR502
R508 10K
+18V
R509 10K
+18V
C506 250
0.6V
R510 33K
C507 33PF
R507 22K
+18V
R512 10K
+18V
R511 1.6K
+18V
C510 250
R517 2.7K
C511 10
0.7V
Q504
3.7V
R518 3.3K
C512 1000PF
470
R520
Q501
5.5V
1V
C504 5
R502 24.4K
R503 15PF
10K
810 10PF
C502
C501 50 PF
R501 1M
R506 1M
R505 1K
CR501
R507 22K
+18V
* FACTORY SELECT
R409 376
R410 100
* C407 3000PF (NOMINAL)
C405 .005 PF
10 TO 10PF
R407 500K
R408 500K
C403 82K
R411
C403 10 TO 10 PF 180 PF
R405 9.88K
R406 1000
R402 10.2K
R403 5K
C402 15 PF
C401 10 TO 10 PF
R401 500K
R404 390K
CR505 R534 330
Q507 34V
Q508 2.2V
C520 50
R535 22K
33V
1.7V
T1
37 VAC
9.5 VAC
37 VAC
115VAC
115VAC
230VAC
S1
POWER
-BB3A CONFIGURATION SHOWN -FOR BB3AB CONFIGURATION SEE DETAIL II
F1
J4
J5
J6
P1
CR102 R106 330
Q101 -30V
R132 3.2E
C101 500
+6V SUPPLY
CR101 R105 33
-BB3A CONFIGURATION SHOWN -FOR BB3AB CONFIGURATION SEE DETAIL III
R110 500
R109 1K TO 20K SELECTED
Q102 -12.4V
R108 8K
-29.4V
C102 150
R107 1M
C103 .01
R104 10M
C104 .01